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USES OF COMMERCIAL WOODS OF THE UNITED STATES.

BEECH, BIRCHES, AND MAPLES.

By Hu Maxwell, *Expert.*

INTRODUCTION.

The three genera, beech, birch, and maple, which include 18 commercial species, besides several species or varieties too small or too scarce to be of commercial importance, form a group closely related. This relationship, however, is commercial rather than botanical. The woods of all have several points of similarity, such as hardness, strength, and susceptibility of fine polish, and in the main their uses are similar. They grow usually in the same regions, and they are often lumbered and milled almost as though they were a single wood, but the resulting lumber is piled and sold separately. It is not unusual in New England, the Appalachian region, and the Lake States for lumbermen to speak of beech, birch, and maple as "the hardwoods," thereby placing them in a group by themselves, separate from oak, elm, gum, and the rest. This is especially true when beech, birch, and maple go to chemical plants manufacturing charcoal, wood alcohol, acetates, and other by-products. These woods in 1909 constituted more than 90 per cent of all the hardwoods employed in distillation in the United States. They made up, also, a large but unknown percentage of the country's hardwood flooring, material for furniture and agricultural implements, and interior finish for houses. In a variety of small commodities they hold first place.

Though there is a general similarity in the properties and qualities of this group of woods, yet each species has its individuality, and in some ways is different from the others, and has different or special uses.

BEECH.

(*Fagus atropunicea.*)

PHYSICAL PROPERTIES.[1]

Weight of dry wood.—44.71 pounds per cubic foot of dry wood (Sargent).

Specific gravity.—0.6883 (Sargent).

Ash.—0.51 per cent of weight of dry wood (Sargent).

Fuel value.—92 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—16,100 pounds per square inch, or 128 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—1,697,800 pounds per square inch, or 128 per cent that of white oak (Sargent).

Very hard, tough, strong, not durable in contact with the soil; difficult to season; checks in drying; takes beautiful polish; medullary rays broad and very conspicuous; color varies with soil, but is usually dark red; sapwood nearly white.

Height, 75 to 100 feet; diameter, 1 to 4 feet.

SUPPLY.

Only one species of beech (*Fagus atropunicea*) grows naturally in the United States, but it is known by different names. Red beech and white beech refer, respectively, to the heartwood and sapwood of this tree, the contrast between the two being marked. The name ridge beech should be regarded as local, for the tree is not confined to ridges more than to bottom lands. The tree known as blue beech or water beech belongs to a different genus (*Carpinus caroliniana*); and the purple-leaved, pendulous-branched species frequently seen in parks and cemeteries is not a native of this country, but is the European beech (*Fagus sylvatica*).

Few trees in this country have a wider commercial range than beech, and in practically every locality where it grows it is cut for market. It ranges from the Gulf of Mexico into eastern Canada, and is found in most regions east of a line drawn from northern Wisconsin to Trinity River, Texas. In 1909 it was cut for lumber in 29 States, and the total output was 511,240,000 board feet, an increase of nearly 90,000,000 feet since 1907. The total remaining stand in the United States has been roughly estimated at from 17 to 20 billion feet, but from the nature of its distribution anything better than a general approximation is impossible. It occasionally forms pure stands, but it is also widely scattered among other species over an immense region. It was once much more abundant than it now is, for in practically all the forested regions of the eastern half of the United States, where farms have been cleared, beech was destroyed

[1] The physical values given for the different woods discussed in this bulletin are largely those of Sargent, and in many cases do not agree with values for similar properties obtained in tests by the Forest Service. Since the Forest Service tests are not yet complete, however, Sargent's data are given in order that a general comparison may be made between the different woods. Engineers and others wishing to obtain accurate values for the mechanical properties will, of course, not use this bulletin for that purpose.

to make room for crops. It was one of the woods least used by pioneers, and until comparatively recent years little attempt was made to save or utilize it. Though much less abundant than formerly, the tree is almost as widely distributed as it ever was. It has not, like shortleaf pine, for example, contracted its limits under the pressure of land clearing and lumber operations. It is a prolific seed bearer, and sprouts vigorously from roots and stumps, characteristics which greatly assist it in holding its ground. The nuts were formerly devoured by countless millions of wild pigeons, and since the annual visits of these migratory birds have ceased the quantity of seed left to germinate is much greater, though it is not possible to determine whether this has resulted in any marked increase in the number of young beech trees.

EARLY USES.

Early records in this country do not make frequent mention of the use of beech, though it was abundant nearly everywhere.[1]

The pioneer settlers who fenced their farms with rails had a well-grounded prejudice against beech because it was hard to split and decayed very quickly when exposed to the weather. It was, therefore, generally classed as worthless for fences. The discovery was made, however, that when under water and subjected to friction, as in mills, it lasted longer than almost any other wood. Axles and shafts for water wheels were made of it. It did not decay if submerged and the water did not soften the wood where the gudgeons and bearings rubbed on each other. No large quantity was demanded by millwrights, for the mills of those days were small, but the wood filled an important place.

Aside from its place in mill wheels the wood had other early uses. In the early glass factories the soldering of handles on carboys, jugs, pitchers, and dishes was performed by aid of a wooden tool, for which beech was the best material because of its freedom from injurious acids which would spoil the work.

The charcoal burners near old-time iron furnaces were the first to send a beech commodity to market on a somewhat extensive scale. Writing in 1749, Peter Kalm said that, next to black pine (*Pinus rigida*), the best charcoal for smithing purposes in the vicinity of Albany, N. Y., was made from beech. The wood filled other impor-

[1] In Europe and Asia an earlier record is claimed for beech than for any other wood, even antedating the sycamore and cypress of Egypt. The words "book" and "beech" were synonymous in some of the earliest written languages coming into Europe, due to the practice of writing on thin beech strips. The existence of the root of the word in Sanscrit has been taken as strong evidence that the wood was used for writing material in central Asia before the migration of the ancestors of the Germanic and Slavonic races westward into Europe. It has been taken as proof also that the alphabets of northern Europe came across the Caucasus Mountains and not by way of the Mediterranean Sea. In beech, therefore, we probably have the oldest existing name of a wood in the world.

tant places in the primitive blacksmith shop. It is very strong and stiff and was preferred as handles for heavy forge hammers. The wood was frequently demanded in the construction of bellows, another indispensable adjunct of the blacksmith shop. Here, too, it was strength and stiffness that gave it a place.

The wood is difficult to work in the carpenter shop and is not especially attractive in color or figure, yet it was sometimes selected when a handsome high-grade article was demanded. Among heirlooms, dating from the time of the Dutch settlers in New York, a carved spoon rack cut out of beech has come down to the present time.

Doubtless by far the greatest use of beech during the two centuries following the earliest settlements on the Atlantic coast was for fuel. It was convenient almost everywhere, and the farmers procured it easily. The large open fireplaces then common consumed enormous quantities of fuel, much of it beech.

ARTICLES REQUIRING FREEDOM FROM TASTE.

Woods which are free from objectionable taste find place in the manufacture of commodities which come in contact with foodstuffs, and beech has long been one of the chief woods so employed. Built-up butchers' blocks are constructed of beech, though not as many as of maple, and for the same reason meat boards, cutting tables in meat-packing houses, and skewers are made of this wood. Lard tubs, butter boxes and pails, and the beaters for ice-cream freezers are other commodities for which beech serves admirably. For ice-cream beaters the persistent hardness of the wood when subjected to attrition and abrasion while wet gives it peculiar fitness. Sugar hogsheads are made of beech, partly because it is a tasteless wood and partly because it has great strength. It is an excellent material for churns. Refrigerators, kitchen safes, and kitchen tables are made of beech in consideration of its freedom from taste and also because the wood is little affected by water. A large class of woodenware, including veneer plates, dishes, boxes, paddles, scoops, spoons, and beaters, belongs to the kitchen and pantry, and beech is one of the common woods of which they are made. Beech picnic plates are made by millions, a single machine turning out 75,000 a day.

It is customary in some parts of the country to filter cider through a mat of beech shavings to improve the taste and deepen the color.

AGRICULTURAL IMPLEMENTS.

The range of implements, machines, and apparatus about the farm, in the manufacture of which beech holds an important position, is wide and varied. In most instances it is employed because of its strength and stiffness. Frequently, however, its cheapness is the

principal consideration. Vehicle makers take it for wagon hubs, sand boards, bolsters, fellies, and sometimes for tongues, though for this last use it is not considered equal to hickory or good ash. It endures severe strain, but if it breaks it snaps short, while ash and hickory do not. The chief defect in a beech wagon hub or felly is the tendency of the wood to speedy decay when alternately wet and dry. It is sufficiently hard to hold the spokes in the mortises, though many other woods fail in that respect.

Fanning-mill frames and parts of windmills, thrashing machines, feed cutters, hay tedders, stackers, ensilage cutters, and many other farm implements are of beech. It is employed for its strength, and sometimes, where it is subjected to friction, because it wears smooth. Garden, lawn, and grain rollers are often of this wood, its weight being one of the properties which fit it for such implements. It is made use of for hayracks and as stanchions in dairy farms. In spite of its weight it is employed for grain shovels and scoops, although lighter woods are often given preference. Beech is one of the best woods for hames because one of the strongest, though metal is largely taking the place of wood for this purpose.

LAUNDRY APPLIANCES.

Beech enters largely into nearly all kinds of wooden laundry appliances, from large stationary tubs down to clothespins. In some cases it is employed because it is plentiful and cheap, but in others for its fitness. Naturally, much of the laundry machinery comes in contact with water, and wooden parts must be able to stand it. Beech meets that requirement. Some of the old-style washboards were wholly of wood, the ridges or corrugations, constituting the rubbing surface, being cut in a solid board. When it was made of wood beech was the best material, because it stood the wear. The wood is still employed in washboards, but is not so essential as formerly. The domestic washing machines which have taken the washboard's place in many homes often have a ridged or corrugated surface against which the clothes are rubbed by machinery. This corrugated surface and the dolly that does the rubbing are frequently of beech.

Clothespins are small articles, but the number made is enormous. In some factories beech is the only wood employed, but several other woods contribute to the country's supply. The remarkable cheapness of clothespins is possible because of the high development of the machines which make them. Squares of wood of the proper size are fed into automatic lathe machines through a hopper, much as grain was passed to the buhrs in an old-time mill. The lathe gives them the required shape, and they are then conveyed to other machines, where the slots are cut by circular saws. After that they are

dried in kilns and delivered to revolving hot-air cylinders, in which they are polished by soapstone mixed with them.

Ironing-board and sleeve-board makers draw some of their material from beech, but seldom all of it. The frames are often of this wood, but the board on which the smoothing is done is generally of some softer wood, such as white pine, cottonwood, yellow poplar, or basswood. A number of other articles classed as laundry appliances are manufactured wholly or in part of beech. Clothes bars, clotheshorses, clothes-drying frames, and curtain stretchers are among them. Other woods are also employed, and the use of beech for these commodities is in most instances due more to its cheapness than to any quality fitting it especially for the purpose. Towel racks and clothes hangers are a little further removed from the laundry, but belong in the same general class of articles.

FURNITURE.

Beech has never been much employed as an outside visible wood, because it has no pronounced grain or figure to make it attractive. Its place is in frames and interior work, where it gives substantial service. It is well fitted for slides along which drawers are moved in and out. It wears smooth, the grain being so uniform that friction seldom develops inequalities. When thoroughly seasoned it absorbs moisture in a smaller degree than almost any other American wood, and this property is important in a wood employed for slides or for drawers which move along them. There is little shrinking or swelling due to atmospheric changes, and consequently little annoyance from drawers sticking fast.

In recent years many styles of filing cabinets and cases have been put upon the market. When this class of office furniture appeared a large demand for beech was created, for its fitness for much of the work was at once recognized. In addition to drawer slides, backs, and bottoms, it was made into partitions, lining, and particularly frames and braces. The tracks on which the slides of extension tables move are often of beech. It has come to be used to some extent in almost all kinds and grades of furniture. Heavy beech veneer—sometimes three or five ply—is a common material for chair bottoms; the wood forms rounds and spindles of cheap and medium grades, and sometimes is nearly or quite the sole material in the cheap hall, camp, steamer, tent, and picnic chairs. It is made into rockers for chairs of more ambitious design, and caster rollers of beech are admirably adapted to service under beds, bureaus, chiffoniers, and other heavy furniture.

The stiffness of beech commends it to the maker of high-grade furniture, but there it is employed largely in built-up panels, and for sides, ends, and tops. Beech veneer is the invisible part, and

some more fashionable or attractive wood is laid over it. Beech dowels are used in the construction of table tops, counter tops, and other large pieces to fasten them together.

Bed slats of this wood are in demand in many furniture factories. They are cheap and stiff. Beech is listed among woods employed in marquetry or pattern work built up of blocks of different colored woods laid over some cheaper material. The color of beech is mild and subdued, and when artistically combined with other woods the effect is pleasing.

Church pews are often made in part of beech; and sometimes, on account of its color, it is the visible wood, particularly for the ends.

FLOORING AND FIXTURES.

A great deal of beech is used for flooring, and it ranks after maple and oak among the hardwoods so employed. In ordinary floors it wears as well, or nearly as well, as maple, and it has the advantage of shrinking and swelling less than most woods. Its best service is perhaps given in factory and warehouse floors, where usage is rough and wear is great. The wheels of hand trucks produce little effect on a well-seasoned beech floor.

The same qualities which lead to the use of beech in marquetry commend it for parquet flooring. It is regularly employed in that way, but it is not as important as are some of the darker and whiter woods, since it does not contrast so well.

Manufacturers of office, bank, and store fixtures employ beech for much of the hidden framework in counters, show cases, cabinets, and shelving. The line separating fixtures from interior finish is not clearly defined, and beech enters largely into both. It is seen in stair work, wainscoting, molding, spindles, brackets, and carved columns and other pieces. It is frequently made into window screens, and less frequently, because of its weight, into screen doors.

In practically all of the uses found for beech the heartwood is given preference. The sapwood is seldom desired. It is claimed by some manufacturers that the value of beech lumber would be increased and its uses extended if sawmills would exercise greater care in separating the sap from the heart lumber.

MISCELLANEOUS.

Beech has a long list of miscellaneous uses and enters into a great variety of commodities. In every region where it grows in commercial quantities it is made into boxes, baskets, and crating. Beech baskets are chiefly employed in shipping fruit, berries, and vegetables, and are of thin lumber, generally veneer, and intended to be used only once. In Maine thin veneer of beech is made specially for the

Sicily orange and lemon trade. This is shipped in bulk and the boxes are made abroad.

Large quantities of beech broom handles are on the market. The wood is not as popular as maple, because of darker color and a little more weight, but its service is as satisfactory. Makers of carpet sweepers find place for some high-grade beech, and it enters more largely into brush backs than any other American wood, due to its ability to hold its shape while alternately wet and dry. Its use, however, is confined to cheaper grades of brushes, and it does not compete with mahogany and ebony.

Beech, because it is smooth, hard, and elastic, holds an important place in the manufacture of children's games and toys. It is one of the best woods for rolling hoops. It serves also as drum hoops and as corners for various gaming boards. The entire crokinole board is often of beech. Rockers for hobby horses, hand sleds, and parts of toy wagons are commonly made of this wood. The stereopticon is a small apparatus and does not require much wood, but beech appears to be used more than all others combined.

There are few musical instruments in which wood is used which do not find beech serviceable for some part. Draw stops in organs, the framework of pianos and pipe organs, the shells of drums, parts of mandolins, and frames and horns of talking machines are often of beech.

It is listed among woods available for weaving and knitting machines, particularly for certain styles of shuttles and spools, and for bobbins in lace-making machines, crochet hooks employed in handwork, and in darning machines. The pairs of concentric hoops for stretching fabric to be embroidered are often of beech, the wood's strength and stiffness making it possible to have such hoops very thin and narrow.

Larger machines and appliances also find this strong, smooth wood valuable. Carpenters' workbenches are frequently made of it, but more particularly the bench screws turned from solid pieces. This tool must stand trying service, and there are not many woods, especially those of moderate cost, that will endure the strain. Other articles for which beech has proved its value are factory trucks, pulley blocks, and parts of weighing machines.

Printers and bookbinders use much machinery, many tools, and various kinds of cabinets and furniture made of wood, and beech, next to sugar maple, is most often employed. Type cabinets and rule cases, as well as the ordinary type cases and case racks, are frequently made of beech. The list of other articles for printers and bookbinders in the construction of which beech is a favorite material includes ruling machines, sewing frames, clamps, galleys, mallets, quoins, sort racks, and wooden type.

Beech is an important handle wood, though not in the same class with hickory. It is not selected because of toughness and resiliency, as hickory is, and generally goes into plane, handsaw, pail, chisel, bundle, and flatiron handles.

Woods lighter than beech are preferred for the sides of ladders, but beech is frequently taken for rungs and steps. In the manufacture of step chairs—a kind of low ladder—beech is sometimes the only material used.

The manufacture of wooden shoes in the United States has reached considerable proportions. Several factories make them, and a number of woods are employed. The two principal qualities insisted upon are lightness and imperviousness to water. Beech lacks lightness, but it so admirably meets the second requirement that it supplies much of the wooden-shoe material. A pair costs from 60 to 75 cents, and is good for two years' wear in cold or wet places, such as tanneries, bakeries, livery stables, street cars, breweries, and laundries. They are also used by farmers. Sometimes the soles only are wood, the uppers being leather or felt. Shoes of this kind are intended for steel mills and glass factories where the workman must walk on hot grates and floors.

Saddle trees, whip handles, trunk slats, boat oars, and mine rollers are among articles made of beech because the wood is stiff, strong, and cheap. It is listed as shoe-last material, but an examination of statistics of output from many last factories shows that its use for this purpose is very small.

The hardness of beech early recommended it for paving blocks, but untreated material proved unsatisfactory because of its speedy decay.

In 1909 the pulp mills of the United States bought 31,300 cords of beech. Several other woods rank above it in quantity, but its place is not unimportant.

Statistics for 1909 show that in the production of slack-cooperage staves, only two woods, red gum and pine, stood above beech in quantity, while for heading, pine alone exceeded it.

PRESERVATIVE TREATMENT.

In 1909 the railroads of the United States bought 195,000 beech ties. Statistics do not show how many of these were treated with preservatives to check decay, but many of them were, for in an untreated state the wood lasts only a short time when laid in tracks. Beech mine timbers are often given treatment, otherwise their life in the damp, spore-laden air of underground galleries is short. If it is to be employed in damp situations, effective treatment lengthens this wood's period of usefulness three or four fold. Its hardness qualifies it for

long service as paving blocks, if properly treated with preservatives. Some of its most promising future uses may reasonably be looked for through the aid of preservative treatment.

DISTILLATION.

The most valuable by-products of beech are obtained by distillation. Mention has been made of early beech charcoal. Methods much more effective and less wasteful are now employed in making this commodity, and a number of additional products are now extracted. Destructive distillation is to-day carried on with great success in large and costly plants. Beech, of course, is not the only wood put through the process, but it is one of the most important hardwoods, the others being birch and maple. In 1909, in the United States, 1,149,847 cords of hardwood were distilled. The kinds and quantities of the products were:

Charcoal	bushels	53,075,102
Crude alcohol	gallons	4,468,083
Gray acetate	pounds	148,769,479
Brown acetate	do	2,156,907
Iron acetate	gallons	302,624
Oils	do	37,995

An average cord of wood by this process of distillation yields:

Charcoal	bushels	46.16
Crude alcohol	gallons	7.37
Gray acetate	pounds	129.39
Brown acetate	do	1.88
Iron acetate	quart	1
Oil	gill	1

The average cost of a cord of wood was $3.32, and the value of the product extracted was $6.65.[1]

These products enter into many arts and trades. Charcoal is used as fuel for home, bakery, and shop, and in blast furnaces, in the manufacture of gunpowder, and for filtration in sugar refineries. Wood alcohol is a fuel, but its principal use is as a solvent in making varnishes and shellacs and in the manufacture of perfumery, dyes, and commodities of a similar kind. The acetates are valuable for making wood vinegar, acetic acid, ether, and acetone.

BY-PRODUCTS.

Beech wood is considered best for the manufacture of pharmacopœial creosote, employed in medicines for pulmonary diseases. This creosote is not poisonous as coal-tar creosote is. The laws of Austria require that pharmacopœial creosote shall be manufactured from no wood but beech. The bark of beech is employed in tanning in Europe, but is so used little or not at all in this country. Oil made

[1] These figures are based on statistics given in "Forest Products of the United States, 1909," pp. 163–167, compiled by the U. S. Census in cooperation with the Forest Service.

from beechnuts is substituted for olive oil in Europe, and the kernels are ground for flour and eaten after the oil is extracted. This suggests a possible use for the nuts in this country. They are occasionally gathered and sold in Canada and in some of the Northern States, but the trade is not large.

SWEET BIRCH.

(*Betula lenta.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—47.47 pounds per cubic foot (Sargent).

Specific gravity.—0.7617 (Sargent).

Ash.—0.26 per cent of weight of dry wood (Sargent).

Fuel value.—102 per cent of that of white oak (Sargent).

Breaking strength (modulus of rupture).—17,000 pounds per square inch, or 136 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—2,042,000 pounds per square inch, or 152 per cent that of white oak (Sargent).

Wood heavy, very strong and hard, compact, satiny, susceptible of a beautiful polish; medullary rays numerous, obscure; color dark brown, tinged with red, the sapwood light brown or yellow. The peculiar luster of this wood, when well polished, is due to the bright lining of the wood pores.

Height, 55 to 90 feet; diameter, 1½ to 4 feet.

SUPPLY.

Sweet birch is found in commercial quantities in half of the States, its range lying chiefly east of the Mississippi River, but crossing a little into Minnesota. No cut is reported from Mississippi, Alabama, Louisiana, or Illinois, but it comes from all other States in the eastern half of the country. The wood is lumbered in rather small amounts compared with some of the oaks and pines, but is of much importance because of its excellent qualities. Exact statistics of output are not available because this birch has been grouped with several others in Government reports of lumber operations. The birch sawmill cut in 1909 was 452,000,000 feet, but this included, in addition to sweet birch, yellow birch (*Betula lutea*), gray birch (*Betula populifolia*), paper birch (*Betula papyrifera*), river birch (*Betula nigra*), and perhaps some of the less abundant species.

The sweet birch on the market comes from several widely separated regions. Nowhere does it form extensive stands. The trees are cut as lumbermen come to them in logging operations among other species, and few if any mills saw birch exclusively. Though it is not known what amount of sweet birch still remains, it is probably much under that of beech, and certainly less than sugar maple. In 1908 a reconnaissance of the standing timber in Kentucky credited that State with 55,000,000 feet of birch, but yellow was included with the sweet. Michigan has been a leader in the

production of this wood for years, and some well-informed timbermen in the State believe there is not 15 years' supply at the present rate of cutting. Wisconsin now leads in the production of birch lumber, but most of it is yellow birch.

The supply of sweet birch in the forests has been diminishing steadily since the settlement of the country began, especially in the valleys and coves among the mountains where the best of the birch has always been found. The narrow and fertile tracts between ranges of hills made good farms and were early cleared. The finest birch went into log heaps and was consumed to make way for pasture and grain. The pioneer's wide fireplace demanded large quantities of fuel, and the splendid birches of the near-by coves were felled and converted into firewood. This process went on from Tennessee to Maine for a century or two, and had destroyed the finest of the country's birch before the value of the wood for lumber was realized. During the past 30 or 40 years sawmills have been putting it on the market, and are now rapidly cutting out the remnants of the splendid but scattered birch forests.

The most difficult problem which the early sawmill man had to solve was to prevent birch lumber from warping. Few woods behave worse when attempts are made to season it in the old way. The only process known by the rural millman years ago was to pile his birch and upon it stack thousands of feet of other lumber. If he succeeded in superimposing weight sufficient to hold the birch straight it slowly seasoned and gave no further trouble. Modern mills using improved methods, have no especial difficulty in seasoning birch.

EARLY USES.

Though in early times sweet birch was used chiefly for fuel, there is evidence that it was on the market as timber more than a century ago. As early as 1791 shipments were going regularly to Clyde and Liverpool.[1] The use to which it was put in England and Scotland is not stated, but at or about that time it was found in New England shipyards. It is stiff and strong, and was suitable for many parts of vessels, if placed where it was not subject to alternate dryness and dampness. In unfavorable situations it is not durable. Small-dimension stock cut from green logs gives much trouble because of its tendency to warp, but large timbers behave better.

Birch is believed to have been the first wood employed as an imitation of mahogany in this country, but the exact date is uncertain. Boston furniture makers were putting it to that service very early. It is still so used, and one of its commercial names is mahogany birch, given it because of its success as a counterfeit. It is called

[1] "Commerce of Europe," p. 542, J. J. Oddy, London, 1805.

mountain mahogany for the same reason.[1] Cherry birch is another of its names, due to its success as a substitute for cherry. It is sometimes called red birch and white birch, the first name bestowed because the heartwood is red, and the second because the sapwood is white. Some designate it as river birch, which is apt to lead to confusion, because that is the proper name of a different species (*Betula nigra*).

While Boston was staining birch and selling it as mahogany in furniture and musical instruments, New York carriage makers were building fine panels of it and finding ready sale for their product without hiding it under false names. There was more temptation from a money point of view a hundred or more years ago to substitute birch for mahogany than there is now. Mahogany was about as expensive in this country then as it is at present, while birch was not half as costly as now. The artistic front of many a chest of drawers passed for mahogany a century ago (and may still pass as such in antique collections), though the wood grew in Massachusetts, New York, or Pennsylvania.

Birch is named in old lists of shoe-last material, but it appears to have passed out of service in that capacity.

FURNITURE.

Among the earliest recorded attempts to make high-grade furniture of sweet birch were those successfully carried out at Boston. Hand-carved arms for chairs were turned out in attractive designs. The early hand processes expanded and developed into manufacturing as the term is now understood. Sweet birch, being a wood of high grade, has been prominent in furniture manufacture from the first successful attempts. It is physically equal to nearly any wood; it is heavy, dense, of good milling qualities, lends itself to stains and fillers, and holds finish well. There is probably no important line of furniture produced in this country which does not make use of some birch. The earliest furniture of this wood seems to have been chairs, and at this day chairs are of sufficient importance to claim first place. The range rises from the cheap camp chair or stool to the finest rocker. The entire article is not necessarily birch; in fact, it seldom is. This wood may supply only the back, the seat, the arms, the rockers, or some of the slats, rounds, or spindles. A special place for it is found in opera chairs, in which three or five ply veneer, the visible wood being birch, is shaped for seats and backs. School desks in large numbers are manufactured in similar patterns. Morris chairs, of which the arms at least are of this wood, are widely sold.

[1] The mountain mahogany of the Rocky Mountains and the Sierra Nevada is a different wood (*Cercocarpus ledifolius*).

and a still higher grade is found in upholstered and plain parlor suits, including davenports, sofas, settees, squabs, and lounges. The heavier of these articles are on casters, which are often of birch, as its hardness and strength fit it for such service.

Several important places in church furniture and fittings are admirably filled by sweet birch, although it is not so extensively employed as oak. It is made into pews, pulpits, communion tables, contribution plates, pulpit chairs, and Bible stands.

It is a popular cabinet wood and enters into the construction of a long list of articles, from kitchen tables and cupboards to elastic bookcases and filing cabinets. It is not always the outside wood, but usually is, especially the richly colored heartwood. It should be borne in mind that there are two kinds of sweet birch, as the cabinetmaker views it—heartwood and sapwood. The difference in color is apparent at a glance, and the workman selects his material for the sake of color. He selects it as carefully for another reason, if he employs glue to fasten the parts together. Birch does not nail readily, because of its tendency to split, and much of it is either dovetailed or glued. If it is glued the best results are attained only when sapwood is glued to sapwood and heartwood to heartwood. Birch appears in many kinds of desks, not only as an imitation of cherry or mahogany but on its own merit. Smoking stands and card tables of this wood are also popular. Children's cribs, folding beds, china closets, extension tables, wall cases, hall trees, taborets, umbrella stands, chiffoniers, and dressers of sweet birch are listed by many factories.

MUSICAL INSTRUMENTS.

Its beauty, strength, and rigidity have made sweet birch prominent as a material in the manufacture of musical instruments. Its beauty, however, is considered oftener than its other properties, for it is usually the outside wood. In some cases, however, its other properties commend it, such as for piano hammers, framework of pianos and piano players, and pipes for organs. Almost every kind of musical instrument in which wood is used has drawn upon sweet birch for material. Special mention might be made of guitars, mandolins, banjos, and violins. Such instruments show the wood most frequently in the necks, although the mandolin is often made of birch and some lighter-colored wood in alternate strips. Drum makers bend a broad, thin band of birch for the shell of this instrument, and in harps it is often the frame, and chosen for its rigidity. In orchestrions or large music boxes, and when employed for cases of pianos and piano players, and for organ cases and musical cabinets, its appearance is the chief consideration. Piano stools and benches are articles in which the fine qualities of well-selected birch are seen to advantage.

VEHICLES.

In its importance as a vehicle wood, sweet birch ranks much below the hickories and some of the oaks, but it fills a number of places. It is well suited for panels, sometimes solid and sometimes of built-up veneers, which find place in fine carriage and automobile bodies. Passenger and sleeping car builders also use birch for paneling. Automobile manufacturers have found several places for sweet birch. It goes into seat frames, floors, filler boards, dashboards, tops, dashboard frames, and steering wheels. It fills some of these places because it is strong and stiff; others because it is handsome. In either case only the highest grade is employed. Some sweet birch is made into hubs, but it is not in the same class as elm and oak for this purpose. It is sometimes seen in the hubs of light carts and buggies. For children's sleds and wagons birch is one of the available woods.

FLOORING AND FINISH.

Sweet birch is a satisfactory wood for flooring, whether the purpose is ornament or long service or both. The wood is handsome, it stands well when thoroughly seasoned, and it lasts a long time. Large quantities of this flooring are made in the Lake States and it finds service in houses of the better class in practically all of the Eastern and some of the Western States. A smaller amount is manufactured into parquet floors and into wood carpet. The dark heartwood is much valued for the last-named commodities, because it forms pleasing contrasts with woods of lighter color.

Ornamental columns of sweet birch find place indoors. Newel posts of the same wood and the associated rails, spindles, and steps of stairways belong in the same class, along with brackets, capitals, chairboards, moldings, grills, and mantels. Window frames, door frames, and blinds of birch are exquisite finish when a dark, rich effect is desired. Birch doors are a special article—that is, particular pains are taken to finish them in the most attractive style, after selecting choice material. Curly birch is often seen to best advantage in this class of work. The wavy grains and figures are matched in the panels, stiles, rails, and mullions. The curly wood is frequently cut into veneer for the double purpose of making it go farther and securing better seasoning. It is not uncommon to equip birch doors with knobs of the same wood. Many birch knobs, however, are used elsewhere than on doors; furniture makers find many places for them. Ceiling is little less important than flooring in the quantity of birch used. A considerable amount of the birch ceiling listed is intended for porches. The wood shows to good advantage in wainscoting, where the dark wood of the heart is sometimes alternated with a white wood such as maple. Floors and ceilings are often made in the same way.

ARTICLES FOR AMUSEMENTS.

A long list of articles for games and amusements are partly or altogether of wood, and sweet birch supplies a liberal share of the material for their construction. Billiard tables are the largest and most costly. Not only does birch enter into the making of the tables, usually as the outside in the form of veneer, but racks for cues and balls, and the cues themselves are often of this wood. The stock of the cue is made attractive by building it up of different colored woods, turned to proper form and highly polished. The makers of bagatelle tables report birch as one of the high-grade woods employed. It is demanded by the manufacturers of a long line of goods found in gymnasiums, including dumb-bells, Indian clubs, and pitch-and-ring. Croquet mallets and balls are on the list also, as are checkerboards, tennis rackets, and numerous toys, particularly building blocks, puzzle blocks, children's games, and wooden guns.

MISCELLANEOUS.

Manufacturers of artists' material use much of the dark heartwood of sweet birch, either in its natural finish or in imitation of mahogany and cherry. The articles in which the wood is found acceptable are easels, maulsticks, rules, palettes, paint boxes, and panels for painting.

Boat builders, who were among the earliest artisans in the country to employ birch, are still rather large users of the wood. It is one of the best for canoe decking and for decking, railing, and finish of motor boats. It frequently passes for mahogany, but some boat makers advertise the fact that they trim with birch. Steering wheels of this wood are very handsome and are to be seen on automobiles, motor boats, and on vessels of larger size.

Much good birch is manufactured into broom handles, though beech exceeds it in quantity. Its dark color is by some regarded as objectionable, and the cost of the wood is also against its employment for handle making. In the manufacture of carpet sweepers, however, birch makes up what it loses in the broom-handle shop. The backs and handles of hair brushes and clothes brushes call for some of the most select sweet birch. It is there in the same class with mahogany, ebony, rosewood, and callitris.

The makers of electrical apparatus need a comparatively small amount of wood, but the quality must be good. Sweet birch is well up in the list and finds place in switchboards, bases for telegraph instruments, telephone boxes, and tables.

It is too costly a wood to be profitably used for ordinary crating and packing boxes, but there are both high and low grades of birch, the latter consisting chiefly of sapwood and pieces too knotty for first-class commodities. This cheap material swells the supply of box lumber, and a little of it is found wherever birch passes through

sawmills. The most frequent objections against sweet birch as box lumber and crating material are that it is hard to nail and is inclined to split.

Apple wood, beech, and sweet birch are important woods for handsaw and plane handles.

It is demanded by manufacturers for tackle blocks, for carpenters' and sheet-metal workers' benches, and for frames for boring machines. In the manufacture of agricultural implements it has a wide range of uses, serving as frames, braces, chutes, hoppers, pitmans, seats, seed boxes, and in numerous other places where strong, stiff, and serviceable wood is wanted.

It is popular for picture frames where a dark wood is desired, and it gives wide service when made into molding for interior finish and decoration. Trunk and suit-case makers manufacture it into slats and veneer, the latter in thicknesses of three or more ply. Another place where it gives good service is for canes and umbrella handles. The same wood is often preferred for blue-print frames and is specially well liked for frames of large cameras. It is seen in tripods, and it is also made into parts of surveyors' and draftsmen's instruments and tools.

Slack coopers press this wood into service with many others, and it goes to market as barrels and kegs. It is given a little better place by woodenware manufacturers, who make tubs and kits of it which are not meant to be thrown away when once used. It appears also in commodities of another class—thin platters of veneer, picnic plates, and butter dishes. Sweet birch, however, is not so well liked for these articles as are yellow and paper birch, maple, and beech.

Fixtures for offices, stores, banks, bars, and hotels require many high-grade woods, and sweet birch is in the list with walnut, cedar, mahogany, oak, cherry, and others. Among the places in which birch is found are counter and bar tops, standing desks for bookkeepers, partitions, cabinets for drugs or other merchandise, show cases, display tables and racks, shelves, and grille work, cold-storage rooms, refrigerators, and soda fountains.

An increasing demand for sweet birch comes from makers of coffins and caskets. Perhaps it is oftener displayed as mahogany than under its own name.

DISTILLATION.

Sweet birch is one of the most important woods which contribute to the hardwood distillation industry described in this bulletin under beech. This process is important because it turns waste into profit, and utilizes portions of trees and mill refuse which otherwise would be lost.

BY-PRODUCTS.

Several by-products are derived from sweet birch. For 200 years white men have made birch beer, and Indians have made it from time immemorial. It is considered a harmless beverage, and is seldom a commercial commodity, but is pretty generally made within the sweet birch's range. The flow of sap from this tree is much more copious than from the sugar maple.

In early summer the soft layer of new wood just beneath the bark is edible. The taste is peculiar and pleasant. It can not be classed as an important article of food, but trees are often peeled to obtain it.[1]

It is said that the characteristic odor of Russian leather is due to birch oil obtained in America and employed in dressing the product.

The commercial oil of wintergreen is frequently made of sweet birch. It is not an article of much value from a commercial standpoint, but it is one of considerable interest. About the year 1863 in Luzerne County, Pa., a trade in the genuine oil of wintergreen (*Gaultheria procumbens*) came into existence. It was presently discovered that sweet birch, by distillation, yielded an oil so nearly like that of wintergreen that only by painstaking chemical analysis could the counterfeit be detected. At first, birch and wintergreen were distilled together in the same vessel, but birch was more easily procured, and it gradually displaced the wintergreen. The industry has continued to the present time in mountainous regions of Pennsylvania, West Virginia, Kentucky, and North Carolina, but it has always been carried on after the simplest and most primitive fashion. A ton of chips yields only 2 quarts of oil, which is used to flavor candy and medicines. The oil consists largely of salicylic acid and wood alcohol. It is not unusual for the mountaineers to sacrifice 100 or more young birches to make a pint of oil.

The supply of sweet-birch lumber must decline, for the tree does not grow rapidly, and the best wood is not produced on the rugged mountain sides where the future supply must be sought. The species has not yet appealed to those who are planting for commercial purposes, and if planted a long time will be required for trees to grow large enough to develop the richly colored heart which gives this wood its chief value.

YELLOW BIRCH.

(*Betula lutea.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—40.84 pounds per cubic foot (Sargent).

Specific gravity.—0.6553 (Sargent).

[1] At the battle of Carricks Ford, W. Va., in 1861, a portion of the Confederate army, under Gen. Robert S. Garnett, was cut off and driven into uninhabited mountains. Sweet-birch bark is said to have saved the lives of hundreds of soldiers. They subsisted upon it several days while making their way over the mountains to Monterey. Years afterwards their line of retreat could be traced by observing the peeled trunks of birch trees.

Ash.—0.31 per cent of weight of dry wood (Sargent).

Fuel value.—88 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—17,000 pounds per square inch, or 138 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—2,478,000 pounds per square inch, or 188 per cent that of white oak (Sargent).

Heavy, very hard and strong, compact, satiny, susceptible of a beautiful polish, medullary rays numerous, obscure; color light-brown, tinged with red, the sapwood nearly white.

Height, 60 to 80 feet; diameter, 1½ to 3 feet.

SUPPLY.

The range of yellow birch extends from eastern Maine to northern Minnesota and southward to Tennessee and North Carolina along the Appalachian ranges. It is a northern tree and reaches its best development near the Canadian border. It is known also as gray, silver, and swamp birch. Its names are all descriptive, but swamp birch may mislead, as it does not grow well in deep, cold swamps, though it is often found around their margins. The young tree is silver white, but as it increases in size the bark takes on a yellow tinge. The wood is not yellow, but the sapwood is white and the heartwood brown, or often reddish.

Within its range the species is fairly abundant, and in the past it has easily met all demands made upon it. It is not probable, however, that it will continue abundant, for it is being rapidly cut, and the changing forest conditions in logged regions are not conducive to new growth of this species. It is, besides, a very slow-growing tree, and a century is required to produce a trunk large enough for small saw timber. It is an abundant seeder, and it disperses its seeds well; but their natural germinating bed is the ground of an old forest with plenty of shade and moss. Old moss-covered logs and rocks buried in moss are favorite sprouting places for the seeds of yellow birch. The roots grow into the ground, and when the log decays the tree is left standing high on its proplike roots. Occasionally a tree stands above a bare rock, with roots down the sides to the ground, presenting the appearance of having grown from a seed which germinated on a naked rock. Forest-grown yellow birches develop tall, clean trunks with small crowns, splendid sticks for lumbering. When grown in the open, however, they are limby. They push vigorously into vacant ground that has been opened by windfalls or fire and also into abandoned fields, and in such situations are often able to hold their place. Few yellow-birch forests of considerable extent, however, are coming on, and the species can not contribute much to the lumber supply after the present stand is cut.

EARLY USES.

Early records showing the use of yellow birch are comparatively few. It was not a wood to attract much attention when forests were

unbroken and many fine species abundant. For that reason it is somewhat surprising that as long ago as 1803 it was listed at Pittsburgh as a furniture material and contributed, together with black walnut and cherry, to the trade in furniture with settlers embarking there for Kentucky, Ohio, Indiana, Illinois, and Missouri.

Before 1803 yellow birch was giving service in Maine, though the amount demanded must have been small. In some instances it was used in ways rather peculiar. The long, slender saplings were cut for withes, which were employed in binding furs and household goods for shipment, for baling hay, and even in binding coffins, though what useful purpose was served in the last case early chronicles do not state. Bent-wood yellow-birch cradles for children were common.

Textile mills came into New England at an early day, and their demand for bobbins and spools was met in part by yellow birch, though it was of less importance for such uses than its forest neighbor, paper birch. Yellow birch is to-day one of the regular woods demanded for spools and bobbins in New England mills, and this service is probably its most important one outside of its use for furniture.

FURNITURE.

Yellow birch is not usually considered equal to sweet birch as a furniture wood, but it is much used, and not infrequently the purchaser of birch furniture buys the yellow without knowing the difference. The better grades of the heartwood are so much like the heartwood of sweet birch that only persons well acquainted with both can distinguish one from the other. When finished naturally—that is, when the grain of the wood is not concealed or doctored by stains—the sweet birch possesses a softened characteristic glow which yellow birch never shows. Yellow birch lends itself well to the finisher's art, and much handsome furniture, strong and substantial, is made of it. The largest use is probably in the Lake States.

In the manufacture of bookcases, chiffoniers, dressers, tables, wardrobes, commodes, couches, lounges, settees, and other household furniture the visible wood, if of birch, is the heartwood, selected for its color, while the sapwood, which is yellow or white and without attractive grain, goes to inside parts, such as drawers, partitions, slides, and backing for veneer. In lessening sawmill and shop waste, a good deal of the strong and stiff sapwood must be worked into something not intended for show, and the manufacturer of furniture has many places where such material can be employed. In cheaper kinds of furniture, like kitchen tables and cabinets, the sapwood can be used for outside parts. It is really more desirable than the heartwood in such places, because it is white and is easily kept clean.

Some makers of morris chairs and large rocking chairs employ much yellow birch, as it is well suited to articles where weight,

strength, and stiffness are desired. It is a good dowel wood because it is strong.

Makers of office furniture draw upon yellow birch for both outside and inside wood. The principal articles into which it goes are desks, large tables and small stands, chairs, benches, and filing cabinets containing numerous drawers and compartments, as well as fixtures for offices, banks, stores, and bars.

VEHICLES.

Yellow birch has not as wide or important a place in vehicle making as have some other woods, but it is well fitted for certain uses because it is hard, strong, and stiff. Its cheapness is often a controlling factor in its use. It has long had a place in hub factories, particularly for small vehicles. The hub is made in a single piece turned down to proper size and shape. In Maine logs down to a diameter of 9 inches are received in the hub factories. The manufacturers of automobiles find it suitable for filler boards and for parts of frames. Factories making gocarts and carriages for children buy yellow birch in considerable quantities and use it for frames, bottoms, and handles. Stone boats, which are strong, heavy, and clumsy sleds for dragging stones short distances, are frequently made of yellow birch. There is a long list of places in general vehicle making where it serves occasionally.

WOODENWARE.

Yellow birch finds a place in practically all kinds of woodenware. A large percentage of the birch broom handles on the market are of this wood, though nearly every other birch contributes something.

It goes into the thin plates and dishes made for pies, butter, lard, and many other commodities, though the quantity used falls much below that of maple and beech. The large number of yellow birch logs in the yards of factories making such plates show, however, that the wood is extensively employed. Statistics of finished products turned out by the industry give little information of species used, the custom being to class everything as "hardwood."

Tubs and pails are sometimes made of yellow birch, provided weight is not objectionable. The wood is twice as heavy as some of the pines and cedars. It does not seem to be specially sought after by this class of coopers, but is employed because it is cheap, convenient, and good enough.

Many small handles for such articles as flatirons, gimlets, augers, screw drivers, chisels, varnish and paint brushes, and butcher and carving knives are made of the wood, some of sapwood, others of heart.

A long list of novelties draw upon yellow birch, including many kinds of small boxes and kegs in two pieces, such as pill boxes, and boxes of soap, toilet powders, medicines, tacks, paper fasteners, school supplies, and other articles almost without number.

MISCELLANEOUS.

The miscellaneous uses of yellow birch range from workbenches and grain doors down to toothpicks. It is not the exclusive material for any of the many commodities into which it is converted, but holds an important place as a contributor. The textile mills make spools and bobbins of it, but paper birch is better. Brush manufacturers find many places for it, but sweet birch and sometimes the heartwood of paper birch are preferred. It goes into millions of toothpicks, but is not generally liked as well as the white paper birch. It is widely utilized for shipping boxes, baskets, and crates, and it is one of the stiffest, strongest woods procurable, but on account of its excessive weight it is sometimes discriminated against. It is excellent for veneer boxes, and that is probably one of the most important places it fills. Citrus fruit from northern Africa and the islands and countries of the Mediterranean is often sent to market in boxes of yellow birch, made from veneer cut in New England. Skewers from this tree are in many markets, but those of hickory are usually preferred, because they show less tendency to split and splinter. Button molds and the wooden body of tassels are frequently cut from yellow birch. Soap sticks draw from the same source of supply. Carefully selected heartwood finds many places in interior finish, such as newel posts, stair rails, chair and baseboards, spindles, brackets, and sometimes panels, partitions, and ceilings. Much of it is unselected for color, since uniform effects in almost any stain can be obtained with both heartwood and capwood.

Other uses for yellow birch are in the manufacture of artists' materials, palettes, easels, rules, and stretchers; tradesmen's triangles and squares, dumb-bells and Indian clubs for the gymnasium; puzzles and toy blocks for children, and novelties of many kinds.

DISTILLATION.

The products of distillation from yellow birch are the same as from beech, for the woods go to the chemical plants together.

Oil of yellow birch is sometimes employed to flavor candy and soda water.

PAPER BIRCH.

(*Betula papyrifera.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—37.11 pounds per cubic foot (Sargent).
Specific gravity.—0.5955 (Sargent).
Ash.—0.25 per cent of weight of dry wood (Sargent).

Fuel value.—80 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—14,900 pounds per square inch, or 119 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—1,841,000 pounds per square inch, or 139 per cent that of white oak (Sargent).

Light, strong, hard, tough, compact; medullary rays numerous, obscure, color brown, tinged with red; the sapwood nearly white.

Height, 50 to 70 feet; diameter, 6 inches to 3 feet.

RANGE AND SUPPLY.

The range of paper birch includes the northern tier of States almost from ocean to ocean, extending into New York, Pennsylvania, Illinois, and Nebraska, and northward almost to the Arctic Ocean. Few trees of this country have a more extensive range, but it is not everywhere of commercial importance. The tree is short-lived, and the trunk is often defective. At best, it is not an ideal timber tree and in some regions where its size is fairly satisfactory lumbermen are inclined to pass it by because of decay. It endures cold, but unfavorable climatic and soil conditions stunt the tree. On Mount Washington, in New Hampshire, at an elevation of 5,700 feet, paper birch is a prostrate shrub. It assumes a similar form near the northern limit of its range in British America; but in other parts of its habitat much good timber is found. The best appears to be in New England, where the annual cut exceeds 30,000,000 feet. In Maine it is rated second in stand among the hardwoods, while farther west, in Michigan, Wisconsin, and Minnesota, it is often mixed with softwoods, such as white and Norway pine, balsam, fir, spruce, northern white cedar, and tamarack. Frequently, however, it grows in pure or nearly pure stands.

It is known as paper birch, canoe birch, white birch, silver birch, and large white birch. It is not readily mistaken for any other tree with which it associates, for the tendency of its bark to roll up in bands around the trunk is a noticeable characteristic. Several birches shed their old bark in strips, but in almost all cases each species has some feature which distinguishes it from paper birch.

It is one of the few American species with a hold on the forest stronger than it had when America was discovered. Large tracts are now covered with this birch where there was little of it a century ago. It is remarkably successful as a fire tree, one that pushes in and occupies vacant spaces left by large forest fires. Some tracts thus taken possession of within a century, or half a century, cover hundreds of square miles. This birch is a prolific seeder, and the light seeds are carried far by wind. When they fall on bare mineral soil, free from shade, they spring up and grow vigorously. Paper birch, however, is short-lived, and when some of the weaker trees begin to fall other broadleaf species get a foothold, and finally the birch is

crowded out. Thus a disastrous fire allows the birch to possess and hold the ground for a time, but it is not strong enough to maintain its position when competition becomes keen. This characteristic must be taken account of when figuring on birch supplies in the future. It has been estimated that enough is in sight to meet visible demands for about 40 years, especially in the northeast, but predictions beyond that period are not made by careful students of the tree's habits and history. Some of the best stands of paper birch in the northeast are in areas denuded by great fires which visited the region from 1825 to 1837. It grows rapidly during its first years, but more slowly afterwards, reaching maturity in from 50 to 85 years.[1]

CANOES.

Paper birch is widely known as canoe birch, because its bark was once employed in making those light vessels. The original makers were northern Indians, and there is no history or tradition when they were not using vessels of that material to navigate the rivers and lakes of northeastern United States and half of British America.[2] It would be difficult to estimate the value of the service of the bark canoe in the discovery, exploration, development, and settlement of the northern part of the continent. From the Arctic Circle to the Great Lakes, for a century and a half, that light but exceedingly strong and serviceable vessel threaded the lakes and rivers, bearing trade and carrying civilization where no other boat could go. The bark canoe was so light that the crew it carried on water could carry it over land from one river to another and from lake to lake, even where mountains lay between. The French explorers and missionairies made journeys of hundreds of miles in these canoes, carrying in many instances cargoes which seem beyond the capacity of such frail vessels. Long distances were traversed in what seems remarkably short time. It is recorded that the first fleet of bark canoes carrying white men reached Sault Ste. Marie, Mich., in 1641, after a journey of only 17 days from the Ottawa River.[3]

The bark of the paper birch seems to meet every requirement for canoe making. It is light, tough, strong, pliable, and resists decay in a remarkable manner. It is not taken from the trunk in single

[1] U. S. Forest Service Circular 163, pp. 10, 11, and 21.

[2] In Longefellow's poem "Hiawatha" may be found a description of the making of the first birch-bark canoe. The account is mythical, but the description of the process of making it is accurate.

[3] There is perhaps no single book that will give more first-hand information concerning the actual use and importance of the birch-bark canoe, when it was employed in the serious business of life, than the journals of Sir Alexander Mackenzie in Voyage from Montreal to the Pacific Ocean, published in London, 1801. The value of the forest resources to the explorer and traveler is admirably shown in the diary of that remarkable Scotch pioneer, who was perhaps the first man to cross the Rocky Mountains with a canoe, which he carried when it would not carry him.

pieces large enough for a canoe (as is done with Sitka spruce on the northern Pacific coast), but in sections 4 or 5 feet long up and down the trunk and as wide as the circumference of the tree.[1] A bark canoe was very strong, and yet so yielding in all its parts that it would stand shocks and blows which would immediately destroy a small boat made of wood or metal.[2]

The birch canoe was not always made for long service. Sometimes it was intended as a temporary makeshift, and in that case the bark was stripped from the trunk in a section 10 or 15 feet long, the ends were rolled up and tied to keep out the water, a few sticks were inserted as cross braces, and the vessel was ready for the slight service expected of it.[3]

The birch-bark canoe was never made and was seldom seen south of the tree's natural range, that is, New England and part of New York, and westward near the Canadian border. The bark canoe is to-day occasionally seen on the northern lakes and rivers, usually at summer resorts.

SHOE PEGS AND SHANKS.

It is commonly thought that shoe pegs have nearly passed out of use, but statistics of the manufacture of the article do not warrant that belief. Eleven thousand cords of paper birch are made into pegs and shanks yearly in New England. A small quantity of other woods is used also. Shanks are small, flat pieces of wood inserted between the soles under the arch of the foot. Joseph Walker, of Massachusetts, perfected his machine for the manufacture of pegs about 1818. It is not apparent that the "invention" of pegs marked the beginning of their use, for it is claimed that handmade pegs were well known before the introduction of Walker's machine.

Two methods of manufacture are now employed in making pegs: One cuts the bolt into blocks of requisite length, and splits out the pegs; the other cuts sheets of rotary veneer the thickness of a peg, and then splits and points them. The waste is large, for though a shoe peg is about the smallest commodity manufactured of wood, it can not be made of small pieces and scraps. The chief waste is due to the rejection of entire defective logs and the heartwood of all others.

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[1] The bark canoes used for carrying merchandise in Canada a century or more ago were sometimes 48 feet long and 9 feet beam, and carried 8,000 pounds.—John Long's Travels, London, 1791, Reported in Early Western Travels, R. G. Thwaites.

[2] Alexander Mackenzie hunted whales with a bark canoe. The animals were found at the mouth of the Mackenzie River, having entered from the Arctic Ocean. He failed to strike the game and concluded that it was probably for the best, as he was doubtful if the canoe would have stood a blow from a whale's tail.

[3] "When they [the Indians] come to a river they presently patch up a canoe of birch bark, cross over in it, and leave it on the river's bank if they think they shall not want it; otherwise, they carry it along with them."—John Oldmaxon's British Empire in America, edited by Hermann Moll, London, 1708.

Shoe shanks are made from rotary veneer which is cut the requisite thickness, and are seasoned after they are cut out.

SPOOLS.

More than half the cut of paper birch in New England is manufactured into spools, the amount exceeding 40,000 cords a year. Nearly all thread spools, such as are used on sewing machines, are of this wood, and no other commodity demands so much paper birch. Two or three properties fit it admirably for spools. Its color is white and attractive, when seasoned it holds its shape, which is the most important thing for a spoolwood, for the least warping would make the winding of thread on it impossible with the delicate machinery employed for the purpose. Though the wood is fairly hard, its dull tools less than almost any other wood fit for spools. This is a valuable quality, for the lathe knives and bits must be kept very sharp or they will not cut true, and the spool will be spoiled. The wood easily takes polish, which is given the spools by rolling them about with balls of wax or paraffin in hollow cylinders.

The whole process of spool manufacture must be followed with care, beginning with felling the trees, which is done in New England in late fall or early winter. Logs 4 feet in length are cut and hauled to the sawmills as promptly as possible, the purpose being to give the wood no chance to stain. Defects due to growth or disease, such as large knots, pith, mildew, red heart, or stain, must be thrown out. The logs are sawed in bars of the required sizes. These, when properly seasoned, are cut into lengths and passed through lathes. A machine turns out a spool a second. The center of the spool industry in this country is in the Piscataquis and Penobscot Valleys in Maine, though there are mills elsewhere. The market for the product is at home and abroad. Scotland has long been a large consumer of paper-birch spool wood, but shipments to that country usually go in the form of bars, and not finished spools. The first shipment of bars to Scotland went from Bangor, Me., in 1882. The trade with that country is now decreasing because birch forests, recently made accessible in northern Europe, supply wood more cheaply.

The largest spools hold 12,000 yards, the smallest 20 yards. It is customary to manufacture the largest in three pieces, and sometimes two kinds of wood are employed, one for the ends and the other for the central shaft.

The rejection of so much wood by the spool manufacturer results in excessive waste. In some instances no attempt is made to use the waste for other purposes, but occasionally novelty mills are operated in connection with spool factories, and special attention is given to the utilitization of what the spool makers reject. In sawing small bars one-half of the log is cut away as sawdust, and this is seldom

put to any use. The red hearts are occasionally worked into brush backs, parts of furniture, or crating. If the slabs are not burned under the boilers they are frequently made into cordwood for fuel in towns and cities.

NOVELTIES.

The term "novelty" is difficult of exact definition, but when made of wood, novelties are generally understood to include miscellaneous small articles, both useful and ornamental. Large numbers of small wooden boxes are made by boring blocks of wood, shaping them in lathes, and fitting lids on them. Paper birch is one of the best woods for this class of commodities, because it can be worked thin, does not readily split, and is of pleasing color. Such boxes, or two-piece diminutive kegs, are used as containers for articles shipped and sold in small bulk, such as tacks, small nails, and brads. Such containers are generally cylindrical and of considerably greater depth than diameter. Many others of nearly similar form are made to contain ink bottles, bottles of perfumery, drugs and liquids, salves, lotions, and powders of many kinds. Many boxes of this pattern are used by manufacturers of pencils and crayons for packing and shipping their wares.

Such boxes are made in enormous numbers by machines. A single machine of the most improved pattern will turn out 1,400 an hour. After the boring and turning are done, the boxes are smoothed by "rattling" them in large cylinders with soapstone.

One-piece shallow trays or boxes, without lids, used as card receivers, pin receptacles, butter boxes, some kinds of fruit platters, and contribution plates in churches are often made of paper birch. When a more expensive wood is wanted, the choice falls on sweet birch, holly, black walnut, mahogany, and rosewood.

Paper-birch curtain rings are popular because they can be made so smooth that they slide readily upon the poles. Collar boxes of this wood, turned from solid pieces, are frequently seen, and wooden candlesticks are among paper-birch products coming from the lathe.

The line separating novelties from woodenware is obscure, but when this birch is employed in the manufacture of clothespins, clothes hangers, lamp mats, card racks, pail handles, and the like, the articles are generally classed with woodenware.

Large quantities of paper birch are made into toothpicks, about 3,000 cords annually in New England alone, which is much more than of all other woods combined. The highest grade is selected, and it must be free from red heart, knots, and other defects. It costs from $15 to $25 a cord. Toothpicks may, therefore, be regarded as the most exacting use to which paper birch is put. The wood is cut in rotary veneer, the length and thickness of the toothpick. This article is occasionally shipped to England, France, and Germany.

Paper birch is one of the many woods entering into the manufacture of door knobs, and it contributes also to button molds—the wooden interior pieces over which cloth or other covering is stretched to make covered buttons. Tassel molds are also made of the wood.

MISCELLANEOUS.

Some paper birch is cut for lumber in the Lake States, though it is not known how large the cut is, for it is listed with yellow and sweet birch without distinction. Much box lumber and crating are drawn from that source, and basket makers use it for fruit and berry shipping packages. The red heartwood—the part rejected by the spool and toothpick makers—is utilized to some extent in Michigan and Wisconsin for canoe decking, chair seats, and opera-chair backs. It contributes to interior finish and is turned for spindles, grilles, stair work, and balustrades. Candy sticks, for stirring candy in process of making, are one of the articles for which the white sapwood is in demand. The wood goes quite generally to excelsior mills in its range, and in Michigan a very fine grade, cut small, is called "wooden wool." This birch is reported in the manufacture of pulp, but the total quantity used can not be large. It is more important in the slack cooperage industry, and the quantity of staves, heading, and hoops made annually is rapidly increasing; but in this industry, as in many others, the several species of birch are not separately reported, and the exact proportion that paper birch supplies can not be determined.

BARK COMMODITIES.

The bark of the paper birch, made into canoes, gave the species great importance long before the wood was of any special value. The Indians put the bark to other uses. They manufactured considerable quantities of maple sugar in the North, and the ordinary storing vessels for their sugar were made of birch bark. Such boxes held from 20 to 70 pounds.

Early settlers made berry buckets and similar vessels by girdling the trees and stripping off the bark in rolls the size of a stovepipe or larger. The peeled, dead or dying trunks of paper-birch trees in many localities in the North are proof that the custom of making such buckets is not yet a thing of the past. Many trees are destroyed to secure the bark, of which only a small part—perhaps a section less than 2 feet long—is taken.

Stationery and other articles are made of paper-birch bark—envelopes, writing paper, visiting cards, programs, and even small books. Occasionally articles as large as tents are made of the bark. Formerly it was often so employed, and sometimes for the roofs of camps and cabins. The bark is the most enduring part of

the tree. Often a prostrate trunk is found in the woods which appears to be sound, but upon examination it is discovered there is little left but bark, the wood having rotted and wasted away.

Several species of birch occur in this country, which are of rather small commercial importance because of scarcity. Each one of them, however, is put to some local use.

GRAY BIRCH.

(*Betula populifolia.*)

Gray birch, known also as white birch, old-field birch, poverty birch, and poplar-leaf birch, is found in commercial quantities in New England and northern New York, where its most noticeable characteristic is its promptness in taking possession of abandoned fields. It is a short-lived, rather small tree, with light, soft, weak wood, which decays quickly when exposed to the weather. It is manufactured into spools, shoe pegs, barrel hoops, and wood pulp, and is often cut for fuel. It grows near the coast as far south as Delaware.

WESTERN BIRCH.

(*Betula occidentalis.*)

Western birch is one of the largest birches of this country, and is found in eastern Washington, Idaho, and Montana, but it is scarce and can not have much value as a commercial wood. Locally it sometimes serves for fencing, fuel, and rough ranch or farm timber.

KENAI BIRCH.

(*Betula kenaica.*)

Kenai birch is a small Alaska tree for which no uses have been reported except for fuel and other purposes about the camps of surveyors and prospectors.

WHITE BIRCH.

(*Betula alaskana.*)

White birch is an Alaska tree with a range extending eastward and southeastward across the Rocky Mountains to the valleys of the Saskatchewan and Mackenzie Rivers. It sometimes attains a height of 60 feet and a diameter of 18 inches, but it is usually smaller. It is abundant in some parts of its range, and when convenient to camps and settlements it is put to common local uses, but it has not been reported in the making of any commercial commodity. It is a most important fuel wood in interior Alaska. Its wood resembles paper birch.

MOUNTAIN BIRCH.

(*Betula fontinalis.*)

Mountain birch is small, and no use other than local has been reported for it, nor does it promise to become important in the future. It is a mountain species, as its name implies. It is found in localities from British Columbia to Colorado, and thence westward to the Sierra Nevada Mountains of central California.

RIVER BIRCH.

(*Betula nigra.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—35.91 pounds per cubic foot (Sargent).

Specific gravity.—0.5762 (Sargent).

Ash.—0.35 per cent weight of dry wood (Sargent).

Fuel value.—76 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—13.622 pounds per square inch, or 109 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—1,560,000 pounds per square inch, or 118 per cent that of white oak (Sargent).

Wood light, rather hard, strong, compact; medullary rays numerous, obscure; color brown, the sapwood much lighter.

Height, 50 to 80 feet; diameter, 18 to 30 inches. The species reaches its largest size in the far South, particularly in western Florida, Louisiana, and Texas.

SUPPLY.

No estimate of the quantity of river birch has been made. The species nowhere forms forests, but is found scattered along banks of rivers, margins of ponds, and in swamps where the land is above water most of the year. The tree will, however, do well on ground subject to rather long periods of overflow. Its range extends from Massachusetts to Florida, and westward to Texas, eastern Kansas, Iowa, and Minnesota. This area exceeds a million square miles, but the actual quantity of the timber can not be judged by the extreme outposts of its range, because over large districts it is not found and in others it is very limited. Among the names by which it is known in different regions are red birch, water birch, blue birch, and black birch.

River birch is one of the few American trees which ripen their seeds in the spring or early summer. The habit of this tree in growing along watercourses and passing uninjured through long periods of inundation suggests that water has much to do in the dispersal of the seeds. The tree, nevertheless, often grows entirely above the highest flood line. It is like the sycamore, in that the situation in which it thrives best is seldom suited to agriculture, because too wet or too liable to frequent overflow. It is, therefore, a waste-land tree,

and is in little danger of extermination to give room to field crops. Though the supply will never be large, it will probably continue. The wood possesses no properties which will cause it to be sought out for special purposes. It is a plain, reliable wood, often used, but never particularly sought after.

Like the paper birch, it is easily identified by its bark, but unlike the paper birch, its bark has no value. In general appearance it is one of the most ragged and neglected-looking trees in the woods. The loose outer bark hangs in shreds or torn strips, and beneath the rents the delicately colored pink-brown young bark is visible.

USES.

The wood of river birch has no characteristic figure or grain. It does not appear to be used for any purpose on account of attractive or artistic appearance. It is as plain a wood as can be found in the forests of this country, and all its uses are based on service or convenience. In Louisiana the logging operators consider it one of the best obtainable woods for ox yokes, many of which are needed. It is stronger and stiffer than white oak, and much lighter, but the principal property recommending it for yokes in Louisiana is its resistance to decay in a climate and under conditions that are very trying.

In Tennessee the slack coopers have found that river birch makes good barrel headings, and it is sometimes employed in preference to other good woods. In eastern Maryland the manufacturers of peach baskets draw supplies from this wood, and substitute it for white elm in making the hoops or bands which stiffen the top of the basket and provide a fastening for the veneer which forms the sides. The birch bends in a satisfactory manner, which is an important point, and in that part of Maryland it is considerably cheaper than elm. In some of the southern States it has been manufactured into flooring for use where service rather than appearance is the chief consideration. It is said to bear considerable resemblance to tupelo as flooring where hard service is required, notably in warehouses, barns, and factories. In many localities it is listed as furniture wood, but usually as interior stock, to strengthen or constitute frames which are to be overlaid with veneers of costlier woods. It is not regarded favorably where high polish is wanted, or where fine varnish or oil finish is to be applied, and for that reason its use as an outside wood in high-class furniture or interior house finish has been rare, although it has been made into mantels in Tennessee, and into spindles for stair work elsewhere.

This wood enters pretty generally into the manufacture of woodenware within its range, but statistics usually do not mention it by name. Observation at a number of woodenware factories in the South has shown this species pretty generally in the log yards, though

not in large quantities. It is employed in the manufacture of picnic plates, pie plates, butter dishes, washboards, small handles, kitchen and pantry utensils, and ironing boards; and is said to possess qualities fitting it in a high degree for wooden shoes, which are now made in considerable numbers in this country. It is light, impervious to water, and is not difficult to work.

SUGAR MAPLE.

(*Acer saccharum.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—43.08 pounds per cubic foot (Sargent).

Specific gravity.—0.6912 (Sargent).

Ash.—0.54 per cent weight of dry wood (Sargent).

Fuel value.—92 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—16,009 pounds per square inch, or 125 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—2,019,000 pounds per square inch, or 153 per cent that of white oak (Sargent).

Wood heavy, hard, strong, tough, narrow-ringed, compact, susceptible of a fine polish, color light brown, tinged with red, sapwood lighter.

Height, 75 to 120 feet; diameter, 1½ to 4 feet.

SUPPLY.

Sugar maple is known in different regions by different names, among them being hard maple, which is more general among lumbermen and manufacturers than sugar maple. The wood is little if any harder than several of the other species of maple in this country. Another name is sugar tree, common among producers of maple sugar. It is often known as rock maple, though a number of other maples are known by the same name. In some parts of the South it is called black maple, or simply maple.

The census of 1909 gave the cut of maple in the United States as 1,166,604,000 board feet, but exactly how much of this was sugar maple is not possible to determine, since in compiling the statistics all maples were classed together. It is reasonably certain, however, that it forms three-fourths of the reported output of maple in this country. Nearly one-half is produced by Michigan, and in quantity of cut that State is followed in the order named by Wisconsin, Pennsylvania, New York, and West Virginia. In all, 34 States reported a cut of some species of maple in 1909, but some of them, notably those in the far Southwest, did not produce any sugar maple, and those in the South produced very little.

The commercial range of sugar maple is roughly confined by the international boundary line from New Brunswick to Minnesota, and southward to North Carolina and Kentucky; but cutting is done here and there outside of these boundaries. The total remaining stand

of this wood in the United States has not been carefully estimated. In 1908 and 1909 a reconnaissance of the timber stand in Kentucky credited all species of maples in that State with about 2,000,000,000 feet. Kentucky is not classed among the maple States, and is probably much below some of the others in quantity. Well-posted lumbermen in Michigan are of the opinion that maple in their State will be cut out in 15 years. At the present rate of cutting a 15-year supply would mean a present stand of about 8,000,000,000 feet. That, however, should be accepted only as an approximation, with the probability that it is too high. The earliest estimate of maple was made prior to 1791 for New York and Pennsylvania by Benjamin Rusk. It could have been little more than a guess on his part, and was probably much too high. In a letter to Thomas Jefferson, published in 1791, he said the two States had 300,000,000 maple trees. If the trees averaged 400 feet each, which is a high estimate, the total stand of maple in the two States was 120,000,000,000 feet. It is doubtful if the entire United States has one-third that quantity of maple now, counting all species.

The sugar maple is in no danger of disappearing from the American forest. It is a strong, vigorous, aggressive species, able to hold its own with any trees on soil suited to it, but it is not a "poor-land" tree. In the north, from New England westward through the Lake States, and southwest to the Ohio and Potomac Rivers, few other species are oftener seen in woodlots. It is slow growing, compared with cottonwood, white pine, and some others, yet it is everywhere in favor.

It is seldom hand planted, because it does not need to be. It is one of the surest and most prolific seeders in the forest, the percentage of germination is high, and the ample wings on the seeds insure their being well scattered. The tree endures shade well, and frequently crowds all competing species out and develops pure stands. In some parts of New England and in the Lake States it takes possession of cut-over lands. When once established it is proof against encroachment by other species. In Michigan it is not unusual for maple to take possession of land from which pine or hardwoods have been cut clean, though such land must be fertile and reasonably well drained.

Sugar maple, in short, promises to become one of the permanent forest and woodlot trees of this country, though it grows slowly. The intrinsic value of its wood is high, and its range of uses is among the widest.

EARLY USES.

Maple shared the fate of many other valuable woods in the early years of the country's settlement, when what could not be used was destroyed. In Rusk's letter to Jefferson, already quoted, he esti-

mated that 6,000 maple trees were destroyed in clearing the average New York or Pennsylvania farm.[1] He suggested that one-third of them should be left standing, not for the wood but for the maple sugar they would yield. He presented figures which he thought proved that the maple trees of the eastern part of the United States could meet a large part of the world's demand for sugar.

It was not possible for the early settlers to use the countless thousands of maple trees cut in clearing land. There were, however, some ways in which they could use part of the timber. Household fuel was always in demand. The large open fireplaces sent probably 90 per cent of the heat up the chimney, but wood was plentiful and was piled in the fire with the utmost liberality. Maple backlogs were in special demand. Long after it had ceased to be a virtue to burn as much wood as possible the farmer laid in his supply of maple backlogs for the winter. As early as 1807 maple fuel was shipped from Maine to Boston.

Charcoal burners cut maple when they could get it. Iron furnaces consumed large quantities in Pennsylvania, New York, Vermont, and elsewhere. Blacksmiths wanted maple charcoal for forges, and this created a wide but not large demand. The charcoal was in demand by gunpowder makers, too, and some of the superfluous maple timber was put to that use, although not enough to make a perceptible inroad on the supply. Potash manufacturers preferred this wood. A century ago the potash shipped from New York and Boston was 80 per cent of maple. The value of maple in the potash industry will be further considered under the heading "Ashes," on page 46.

The characteristic rifle stocks of pioneer days were usually of curly maple, because the wood was strong and stiff and could be worked down very small without endangering its usefulness. The wood was carefully selected to display the curly and bird's-eye effects to best advantage.

Violins were not abundant in this country in early times, but they were occasionally made, and the material was largely figured maple. The makers of those instruments constantly kept choice maple in stock, air-drying it during several years.

Runners of sleighs were largely of maple, and sled soles were frequently made of it. Occasionally it was made into ox yokes. The wood has great strength under constant strain, but is apt to break by sudden jar.

Various articles of household necessity were made of maple, such as rolling pins, potato mashers, butter printers, bread boards, chopping blocks, ladles, and bowls. A place for it of more than ordinary

[1] Transactions of American Philosophical Society, vol. 3, p. 64.

importance, given because of its hardness and smoothness, was in the homemade spinning wheels found in most pioneer cabins where flax was spun. These were known as "little wheels" to distinguish them from the "big wheels" employed almost exclusively in spinning wool. The reel, a companion piece to the spinning wheel, generally had maple for the crosspiece on which the thread was wound.

The old-fashioned shoemaker fastened his soles with maple pegs when he could not get pegs of paper birch. Before they were split and pointed by machinery he whittled them by hand. Lasts of maple were the usual thing, though other woods answered very well.

Maple saddletrees were part of the stock in trade of most saddle makers in pioneer times, as at present. The millwright made his cogwheels then, and the teeth of the homemade pinions and trundle-heads were frequently of maple, provided they were not to be exposed to dampness. Maple filled a number of places in early shipbuilding, though it was of less importance than some other timbers. Maple knees, keels, and keelsons are mentioned in shipyard supplies. Maple broom handles were in use nearly a century ago, and their handsome appearance and the good service they gave were subject of special mention.

Maple has been a furniture material ever since furniture has been made in this country. Chair makers seem to have been among the first to discover its good qualities. When mahogany was the fashionable furniture wood curly maple was a choice inlay. It is not unusual to find antique pieces of rare beauty and generations old. The white wood contrasts well with the darker mahogany. Sometimes sugar maple was used, sometimes red maple.

Maple lumber in early times was not much used for building purposes. An occasional exception was found in kitchen floors. The boards were from 6 inches to a foot wide, wore smooth, and became very hard. Service was what was wanted, and maple gave it.

Wooden dishes were comparatively more common in the years succeeding the earliest settlement of the country than they are now, because then many persons were under the necessity of making nearly all of their household articles. John Lawson, whose writings were published in 1714, gives maple a place of honor as material of which "dishes, trenchers, and spinning wheels" were made in the Carolinas.

It was among the earliest of the hardwoods exported, and special mention is made of its use at Keighley, England, in the manufacture of washing machines and mangles.[1]

The Iroquois Indians of New York made paddles, spoons, and ladles of sugar maple. The only recorded attempt of the American Indians in manufacturing and employing cannon to attack forts occurred during the siege of Fort Henry (now Wheeling, W. Va.)

[1] The Trees of Commerce, William Stevenson, edition 1908.

in 1777, when they made their cannon of a maple log and wrapped it with chains. They fired it only once, however, for it burst with disastrous results.[1]

No sharp historical or geographical line separates the primitive and local uses of maple from the employment of the wood for manufacturing purposes, as the term is now generally understood. The change was gradual and went on in many places until what was a century ago a material whose very abundance often made it a nuisance has become one of the most important woods in American factories. It began to enjoy a high place when special commodities, manufactured by machinery, found general sale.

FLOORING.

The making of matched flooring by planing mills may be considered as the beginning of the flooring industry. Between 1870 and 1880 attempts were made to introduce floors of maple and black walnut in alternate strips. When well finished the effect is pleasing. The rich black of the walnut and the clear white of the maple were attractive, but the floors were not satisfactory when subject to severe use. The walnut was softer and wore more rapidly than the maple, and the floors became uneven. Wainscoting of the same kind had been introduced to match the flooring, and though not subject to wear, it lost its popularity when the combined walnut and maple floors went out.

Soon after this the roller-skate craze struck the country, and maple flooring was instantly in demand. It was the best obtainable material for rink floors. Its permanent place in the lumber industry may be dated from that time. Its good service in rinks led to its use for other floors, and also for finish, and then for furniture. At the present time half the maple output is for floors. Care in seasoning and laying it is necessary, for if placed green it shrinks badly, or if dry when laid and later allowed to become damp it swells up in ridges. But when properly managed it is one of the very best of floor woods with lasting qualities of the highest order. Instances have been cited, apparently well authenticated, where maple has given longer service under excessively trying conditions (stair landings in large stores) than marble.

The modern manufactured flooring is much narrower and often much thinner than the old-style flooring turned out by sawmills generations ago. Modern flooring varies in width from an inch to 2½ or 3 inches and in thickness from three-eighths of an inch to thirteen-sixteenths of an inch. It is dressed true, and the tongues fit into the grooves almost perfectly. The three-eighths-inch flooring

[1] Chronicles of Border Warfare, Alexander S. Withers.

weighs about 1,200 pounds per 1,000 surface feet; the five-eighths-inch weighs 1,800 pounds; and the thirteen-sixteenths-inch weighs 2,100 pounds. These weights are for thoroughly seasoned wood. Flooring is often made of other species of maple not quite the same in weight as this.

Sugar maple is one of the woods employed in the manufacture of parquet flooring, but the quantity demanded by that industry is comparatively small. Maple often composes the white wood blocks and strips in that work and is combined in patterns with woods of darker color.

LASTS.

Several woods are listed as last material, but maple greatly exceeds all others. The annual demand in Massachusetts for this commodity is about 13,000,000 feet, and in Michigan a little more, and these two States are among the highest in last production. The reports from these two States mention no wood other than sugar maple, except that softwoods serve for lasts or "trees" for rubber boots and shoes.

Maple is considered the best for lasts because it is hard, finishes smooth, checks but little when carefully seasoned, and does not warp out of shape. The wood is carefully selected, and none but the best is used. Knots or other defects spoil it for lasts. Billets or bolts are split from logs usually sawed long enough for three lasts. Each billet therefore makes three last blocks. The seasoning is carefully done and is a slow process, for before the wood is placed in the kiln it is air dried for from one to two years. The last maker will reject a block containing season checks or cracks, which will not be cut out when the last is turned in the lathe.

There are as many sizes of lasts as there are sizes of shoes, and there is as great variation in style as in size. Every change in fashion of footwear, moreover, demands a change in lasts. This year's style of shoes, if different from what went before, can not be made upon old lasts. For that reason old stock must frequently be laid aside or thrown away and a new and different style substituted. This gives the last makers a constantly changing field of trade.

Lasts are usually made by machinery, but every one is turned exactly like a pattern, and the pattern must be slowly and carefully whittled out by hand. The making of the pattern is the most exacting work in the trade. When a new style of shoe is demanded the pattern maker is set to work to produce the model. He uses maple for the most part, and when he has worked it down to satisfactory shape and size the corners and angles are covered with steel to resist the wear of the machinery. It is fixed in the lathe and revolves hundreds of times for every last that is made like it, and a machine

should make a hundred or more a day. A considerable amount of sugar maple is shipped to England, where it is manufactured into lasts. Lasts made in this country are shipped to all parts of the world where people make leather shoes, but the best market is in the United States. The final purchasers are not only the large manufacturers but every shoemaker and cobbler throughout the land.

The waste of wood in such a factory is large. From one-half to two-thirds of the rough split block is cut away as dust and shavings.

BIRD'S-EYE MAPLE.

A large use of maple wood for furniture, musical instruments, and interior house finish is due to a pleasing growth called "bird's-eye," which adds much to the beauty of the wood when highly polished and carefully matched. The most probable explanation of this figure is that it is due to buds, which for some reason can not force their way through the bark, but remain just beneath it year after year during long periods. The young wood is disturbed each succeeding season by the presence of the bud and grows around it in fantastic forms. When such a tree is converted into lumber, the saw cuts through the abnormal growths, exposing the crumpled edges of the tilted annual rings.

Curly and wavy maple are accidental forms which frequently occur and are highly prized by furniture makers and other manufacturers of high-class commodities.

FURNITURE.

Sugar maple stands near the top of the list of furniture woods in this country. Statistics have never been collected to show the comparative rank of different species in quantity used, but white oak is probably first. Sugar maple is third in Massachusetts, third in Maryland, first in Wisconsin, and second in Michigan. Some woods are given place in furniture making only as inside, concealed material, others only as the outside, visible portion, but sugar maple serves in all parts. It is strong, rigid, and durable as frames and as slides for drawers and the sections of extension tables. It may be used in the form of very thin lumber, or as built-up sections of veneer, for the bottoms of drawers and partitions between compartments in desks and filing cabinets. Its white color is one of the qualities which fit it for that place. A coarser class of service is found for it in the manufacture of cot frames and the frames of couches, as well as for almost all kinds of furniture. Its hardness makes it suitable for casters for heavy articles of furniture. It is difficult to split when well seasoned, a quality in which many hardwoods are found deficient. Three-ply maple veneer is much employed for chair seats and backs. Maple stood third highest in the United States of all woods

used in the manufacture of veneer in 1909, but only a portion of the veneer found place in furniture making. In quantity maple (all species combined) was surpassed by red gum and the southern yellow pines.

Sugar maple is a choice wood for kitchen cabinets, tables, and shelves. It is clean and white, so hard and dense that it does not readily absorb impurities, and its surface is easily washed.

A rather large quantity of it is made into mission furniture, some of which is left in its natural color. The wood may be stained a green gray by applications of copperas water. The makers of willow and rattan furniture employ sugar-maple rods to give form and strength to their commodities.

The bulk of the first-class maple demanded by furniture manufacturers is made into bedroom suites, wardrobes, house desks, library tables, wall cases, bookshelves, chiffoniers, rockers, children's cribs, and similar articles. It is here that the bird's-eye and curly maple are most frequently seen and where the artistic workman can most effectively display his skill. The best bird's-eye stock is generally reduced to veneer and spread in thin sheets over scores of cheaper woods.

INTERIOR FINISH.

The use of high-grade figured maple as interior finish does not differ much from its employment in furniture making. The best wood is reduced to veneer and laid on cheaper backing. Wide panels in ceiling or wall are possible, for the veneer may be had in large sheets, cut by the rotary process. The manufacturers of material of that grade discourage the employment of fillers preparatory to finishing the work, but recommend natural colors.

The general use of maple flooring calls, in many designs, for interior finish to match. Stairs are made of the wood. It wears well where use is hard, and it carves well where ornamentation is desired.

Maple doors are in wide demand. They are heavy, but are slow to warp or sag, and give little trouble on account of getting out of shape.

Fixtures for stores and offices, such as counter tops, shelving, cabinets, show cases, display racks, and seats and benches, are occasionally of maple, though generally darker woods are better liked.

VEHICLES.

Sugar maple is very strong, but its tendency to break by sudden jolt or jar places it at a disadvantage in some parts of certain kinds of vehicles, yet it has a wide range of uses in which it gives satisfactory service. It is maintained by some that tapping trees in the process of sugar making weakens the wood by the introduction of incipient decay; but as far as the commercial use of the wood is

concerned the matter is not important, for a very small per cent of the maple lumber on the market is from tapped trees. Wagon axles of sugar maple are considered by some as good as any. The heaviest two-wheel log trucks used in Michigan have axles of this wood 8 inches square, with wheels 10 feet high. Such an axle sometimes carries 20,000 pounds over rough log roads. Maple is employed for wagon beds, though its weight is against it, as frames for buggies, dashboards for carriages and light business wagons, and its use for buggy shafts has been reported in Kentucky. It is widely employed in the manufacture of small vehicles, as baby buggies, go-carts, and children's wagons. It is good sled material and is one of the common woods in cutter and light-sleigh manufacture, entering into practically all parts of the vehicles, but is particularly liked for the soles of heavy sleds. Its hardness and smoothness insure easy running and long service. Sugar maple is recommended for handles and other parts of gocarts and for baby carriages which are to be finished in white enamel. The wheelbarrow manufacturer, in certain localities, employs scarcely any other wood, while in other places the handles are of sugar maple and the body of white elm or some other tough wood.

Car builders make use of maple for many purposes and in cars of many kinds. Its white color gives it a value as finish for the interiors of electric cars, and occasionally for steam coaches and Pullmans. Service of a different kind is found for it in log cars, where it goes into frames and bunkers. Platforms of push cars and trucks employed about factories and railroad stations are frequently of sugar maple, as are the frames of railroad velocipedes.

An important demand comes from manufacturers of bicycle rims, and this rather small commodity requires several million feet annually of select maple.

The rapid rise to importance of automobile manufacture has created a new demand for sugar maple, largely for benches, bottoms, subfloors, and frames.

HANDLES.

As a handle wood sugar maple is not in the same class with hickory. The latter is demanded more for its toughness and resiliency than for its strength, though the latter quality is duly considered. Maple is not tough or very resilient, but it is nearly as strong as hickory. Its important position as a handle wood is due chiefly to its hardness, smoothness, strength, color, and cheapness. It is not well suited for ax handles or slender hammer handles, because sudden jars are likely to snap it; but for stiff handles, not subject to much bending, it is one of the best available woods. It is not known how much of it is made into handles, but the total is probably not much below the

quantity of hickory. The largest part doubtless goes into broom and mop handles. The State of Michigan alone puts more than 20,000,000 feet of the wood to that use annually, and in Wisconsin sugar maple is the principal material in the broom-handle industry. Next to white birch it is the leading handle wood in Massachusetts. Farther south it is not so plentiful and does not attain to the important place it holds in the north.

Sugar maple contributes liberally to a very large class of small handles for tools, such as chisels, augers, gimlets, gauges, hammers, mallets, monkey wrenches, and especially the tools used by wood engravers, shoemakers, and tanners, and by tinners and other sheet-metal workers. Maple is one of the many woods used for pail and package handles, which are made in large numbers. In the manufacture of whip handles in Massachusetts sugar maple holds first place. Brush handles of all kinds also draw heavily upon this wood.

The makers of cant-hook handles select clear maple that will split nicely, for there must be no cross grain. The cant hook and the similar tool called the peavey are used for rolling logs and are subject to great strain, but not often to sudden jolts, and strength is the main thing. If these handles are made from sawed squares, cross grain may result, rendering the tool unreliable. The snapping of a cant-hook handle at a crucial moment may not only defeat the logger's efforts, but endanger the lives of the men by precipitating a skidway of logs upon them. Sugar maple is employed for several tools, such as handspikes, levers used in mills and in turning capstans on shipboard, and for pickeroons or poles with pikes used by log drivers on rivers.

Snaths, or the bent-wood handles of scythes, are split from logs to make sure there is no cross grain. Sugar maple, however, is not as often employed as white ash, hickory, and red mulberry. Other bent-wood handles occasionally manufactured from sugar maple are for parasols and umbrellas. Here, too, maple is not as important as some other woods, and in quantity it is perhaps surpassed for umbrella handles by the diminutive nannyberry bush of New Jersey (*Viburnum prunifolium*).

MUSICAL INSTRUMENTS.

When sugar maple is made the outside, visible wood of pianos, bird's-eye or curly growth is generally selected. Maple is rarely finished to imitate any other wood. The bird's-eye maple is frequently seen in violin sides and in other small instruments, but the curly or wavy growth is usually preferred where the surface exposed is small, because it can be displayed to better advantage than the bird's-eye. Though occasionally accorded a prominent place as an outside wood in the making of musical instruments, maple is oftener hidden

within. In piano construction it goes into the action parts, the bridges and pin planks. Player pianos nearly always use some maple. It is often found in banjos, guitars, mandolins, and in music boxes and talking machines. Its use in music cabinets, racks, and in piano stools and benches perhaps should be listed as furniture. The hoops of drums, and the shells also, are frequently maple. Young growth, called second growth by some manufacturers, is preferred for drum hoops, because it bends more readily than old wood. Some of the best selected bird's-eye and curly maple is seen in expensive harps. Illinois is one of the largest centers of the manufacture of organs and pianos, and in that State, according to reports compiled in 1909, more sugar maple is used than of any other of the 29 woods demanded by those industries. Chestnut stands second in that State. In the manufacture of musical instruments of all kinds, sugar maple stands second for quantity in Massachusetts, third in Michigan, and fourth in Wisconsin and Maryland.

AGRICULTURAL IMPLEMENTS.

The list of apparatus, appliances, and machinery included in the general term agricultural implements is so long and varied that their enumeration is scarcely practicable; yet through the entire list sugar maple holds an important place. In Illinois, which probably produces much more farm machinery than any other part of the country of an equal area, 20 woods are given in reports on this industry. Of the five most important, sugar maple stands first.

	Feet.	Cost.
Sugar maple	24,564,000	$931,970
Longleaf pine	24,159,000	688,924
Shortleaf pine	15,600,000	405,870
White oak	10,366,000	481,956
Cottonwood	5,469,000	193,504

The 15 other woods entering into the manufacture of those commodities in Illinois total 23,491,000 feet.

In few cases in the making of agricultural apparatus is maple or any other wood employed solely for appearance. Strength and hardness are the prime requisites, and sugar maple enters all parts of machines where strain or wear must be resisted. Statistics of the woods employed by makers of farm machinery and apparatus in the State of Michigan show that sugar maple enters largely into bean pickers, baggers, corn shellers, corn huskers, corn planters, cultivators, ensilage cutters, feed cutters, grain separators, fanning mills, hay balers manure spreaders, potato planters, self-feeders, shredders, thrashing machines, wind stackers, horsepowers, and riddles, as well as into many utensils classed as tools rather than machines, such as hand rakes, grain shovels, pitchforks, measures, feed troughs, and snow shovels.

In the manufacture of farm machinery, however, maple does not go as far outside its geographical range as do some other woods, particularly longleaf and shortleaf pine of the South. The use of maple for that purpose declines rapidly as the distance from the source of supply increases. In North Carolina, Kentucky, Arkansas, Louisiana, and Missouri sugar maple is not very important in the manufacture of agricultural machinery. Other woods can be procured at less cost. However, there are no centers in those States where farm machinery is made on a large scale as there are in Wisconsin, Michigan, and Illinois, near the maple supply.

WOODENWARE.

Sugar maple is widely utilized in the manufacture of woodenware. Some factories making pie, butter, and picnic plates use maple exclusively; others accept nearly any hardwood that has no pronounced taste or odor. A brief summary, but by no means a complete list, of woodenware into which maple enters would include bread boards, meat boards and the tops of tables where meat is cut, rolling pins, meat mauls for pounding steak for broiling or frying, wooden spoons, butter ladles, molds, printers, bowls, churns, especially the dashers, lemon squeezers, kraut cutters, and potato mashers. In articles of this class it is highly important, for sanitary reasons, that the wood be sufficiently hard to resist bruising and splintering, and it should not check and present open crevices in which organisms or impurities can find lodgment. Sugar maple meets these requirements better than most other woods. Its hardness, nevertheless, is in one way disadvantageous because of difficulty in working it.

A class of woodenware made in cooperage factories is used for the shipment of food products, and sugar maple is one of the woods employed. In the making of sardine kegs the hoops and staves are of maple and the heading of white ash. Anchovy kegs frequently have willow hoops, but the heading and staves are maple. Lard tubs, butter tubs, and cheese boxes are often of sugar maple, and it is one of the best woods for faucets. Many kinds of pails are of the same material, especially sap buckets used by sugar makers in the North. Flour barrels and sugar hogsheads belong properly to slack cooperage, and maple is often employed in their manufacture. In the United States Census reports for 1909 this wood was credited with 118,000,000 staves, 13,000,000 sets of heading, and 700,000 hoops.

The use of sugar maple in certain kinds of woodenware is not due to absence of taste or of staining material in the wood, but to desirable features, such as hardness, smoothness, agreeable color, and cheapness. Garment hangers are in that class, also display racks and dummies, candle pins, and a pretty complete line of apparatus for the

laundry, including washing machines, wringers, mangles, towel racks, ironing boards, sleeve boards, wash benches, washboards, clothes racks, and clothespins. In the same class belong cigar boards, where the tobacco leaves are cut and rolled, and lapboards on which the cobbler, saddler, and harnessmaker trim leather and fashion it. The clamps for holding articles while working on them are frequently of sugar maple.

MISCELLANEOUS.

The miscellaneous uses of sugar maple are so many that little more in the way of enumeration can be attempted than to indicate the industries where they are found, and even this outline must be incomplete.

Wherever the maple grows in commercial quantities it is made into shipping boxes and crates, but it is seldom specially sought after for this purpose. It is heavy and adds to the freight item, but it is strong and stands hard usage. The shippers of tin plate place it among the best woods in their business, and in that instance special effort is made to get it. Furniture factories use large quantities of low-grade maple for crating. They like it, not only because it is strong and dependable, but also because it holds nails well. Large numbers of very light boxes of veneer are made for shippers of berries, small fruits, and for some kinds of garden truck, such as string beans, celery, young onions, and spinach. Maple boxes are not often used for shipping bulky merchandise. Veneer boxes, but with ends and center partition of thicker wood, are exported as shooks to Sicily for shipping lemons.

Many built-up butcher blocks are of sugar maple. The old-style block, all in one piece, was objectionable on account of season checks which provided lodging places for impurities. Formerly most of the blocks were of sycamore, all in one piece, but maple now seems to be more largely used. However, in the two States of Illinois and Michigan the annual demand for butcher blocks is 1,600,000 feet of sycamore, 1,300,000 feet of maple, and 1,300,000 feet of beech. Maple skewers are nearly everywhere listed in butcher supplies, and veneer sausage trays of the same wood are used by retailers.

Printers and bookbinders are large purchasers of sugar-maple products. Type cases, and often the stands and cabinets where they are kept, are of this wood, as are mallets, furniture (small quadrangular pieces), planes, and wooden type. Preparation of the wood for type is very careful, often including boiling in water, air drying many months, then kiln-drying, and finally oiling. Base blocks for mounting stereotype and electrotype plates and halftone and zinc engravings are frequently of this wood. It is also a liberal contributor to artists' material. It is made into easels, maulsticks,

rules, palettes, picture frames, and panels on which pictures are painted.

Its use in the manufacture of athletic goods and apparatus and in the boards and other paraphernalia for games is general. It is frequently seen in baseball bats, croquet balls and mallets, billiard cues and rings, and in dumb-bells, horizontal bars, Indian clubs, and carom cues and rings. Bowling alleys find no wood better suited, and it is made into tenpins and racks and into frames for boxing machines.

In the manufacture of shuttles, spools, and bobbins sugar maple holds an important rank. It stands first in North Carolina (though some silver maple may be included) and second in Massachusetts, where it is exceeded by paper birch. It is often seen in large spools made in three pieces, it being the central shaft on which the ends are fastened. The wood is made into picker sticks for cotton mills in North Carolina, and forms parts of looms and weaving and spinning machines.

Carpet sweepers are often made of maple, and the easels or racks where the sweepers are kept when not in use are of the same material. It is a common material also in the manufacture of school apparatus, such as stands for globes, frames on which to display charts, blocks illustrating mathematical forms and figures, and material for manual training classes.

Round measures, sometimes called "nest boxes," are frequently of this wood, particularly the bent wood forming the sides. This is of thick veneer, usually one ply, but occasionally three. The utensils are used in grocery, grain, and seed stores, and by millers and farmers. In capacity they range from a pint to a bushel. Sieve rims belong in the same class.

Sugar maple competes with black gum for first place in the manufacture of rollers of many kinds—those employed in moving houses and other very heavy bodies; in off-bearing tables of sawmills; in shoving timbers ashore from ships and boats; and in mines as runways for cables. The wood is exported to England for mine rollers. Land and lawn rollers of several sizes are made of sugar maple.

The pipes employed to carry away the impure water from coal mines, particularly the Pennsylvania anthracite mines, are required to withstand strong chemicals. Many operators prefer wood to metal, and maple is among the best woods for the purpose. Similar pipes serve in tanneries and packing houses.

In Massachusetts maple is more largely employed in brush-back making than any other wood except paper birch. It is in demand for blue-print frames and the printing frames used by photographers, for die blocks and die-block cases, and for gas-engine skids and the frames for portable sawmills. Pulley makers find the strength,

hardness, and smoothness of maple serviceable in their business. Rings of many sorts and sizes are manufactured from this wood—curtain-pole rings, gymnasium rings, martingale rings, and many used in industries, games, and arts. Canes and crutches are in the list of maple commodities, as are tripods for photographers and surveyors; screws, gauges, and benches for carpenters and other mechanics; and tool chests for workmen.

Fuel makes very heavy demands upon sugar maple. It is cut in the woods, but the largest supply of fuel probably comes from slabs at sawmills and tops and limbs left in the woods by log cutters. The mills in Michigan and Wisconsin which saw maple logs find large sale for slabwood in Chicago, Milwaukee, Detroit, Cleveland, Toledo, and other cities and towns on the Great Lakes.

DISTILLATION.

Maple is one of the three principal hardwoods used for distillation, the two others being beech and birch, as previously described.

ASHES.

Ashes are so often a waste product that their value is seldom thought of, yet they have been and still are of industrial importance. Sugar maple stands first as a producer of the commodity. Almost immediately after the settlement of this country the colonies shipped ashes to England. In 1621 the Virginians were selling it there at 6 and 8 shillings per 100 pounds, but the different species which produced the ashes are not recorded. Later 80 per cent of the ashes exported from Boston and New York was made from sugar maple. In the maple regions just over the line in Canada the burning of ashes was made a business, and doubtless the same business was found in near-by parts of the United States. Annual exports of potash and pearlash from Canada, at a comparatively recent period, represented 20,000 barrels of ashes. Most of the material is used to make soap for the British Navy.[1]

The use of ashes in this country in former times for making soap was very general. In farmhouses and villages each family made its own, just as it made its own clothing and shoes. Wood ashes—not necessarily maple, though that was considered best—an ash hopper where the leaching was done, a lye trough, kettle, grease, and a sassafras soap stick for stirring constituted the usual rural family soap-making establishment.

Ashes, maple and hickory preferred, were once in very general use for curing meat, particularly bacon. At the present time some of the largest meat packers in this country smoke bacon with sugar-maple wood. Thousands of cords a year are so used.

[1] "The Potash Salts," L. A. Groth, London.

The largest demand for wood ashes in this country has always been for fertilizers. It is claimed that the Massachusetts Indians taught the Plymouth colonists the value of ashes in growing crops.[1]

SUGAR.

There is no account of the beginning of sugar making from the sap of maple. The Indians from Carolina to Canada knew the art before white men came.[2]

The first settlers made sugar as soon as they came in contact with the sugar maple. They imitated the Indians at first, though their tools and apparatus were better.

There is wide difference in the quantity of sugar which single trees yield in a season, the range being from 2 to 40 pounds, the average, however, not being much above the lower figure.[3]

It is usually considered that from 16 to 20 quarts of sap make a pound of sugar. This article is now generally regarded as a luxury, if it can be had pure, but it was formerly not much used by persons who could afford to buy West Indies cane sugar. In 1791 it was published, with evident patriotic pride, that Thomas Jefferson used maple sugar exclusively, and that to assure a future supply at his farm near Charlottesville, Va., he had planted a grove of maple trees.[4]

Exact figures on the sugar and sirup output are difficult to obtain, because many farmers do not make returns to the collectors of statistics, and, further, because much of the product is adulterated before it reaches market. In many cases maple sugar is used to flavor sirup or sugar made from cane or beets. Hickory bark also has been used as flavoring material. Adulterations of maple sugar and sirup have been many and widespread.

BLACK MAPLE.

(*Acer saccharum nigra.*)

The black maple is a form of sugar maple which is found from New England to South Dakota, eastern Kansas, Arkansas, and west of the Allegheny Mountains to northern Alabama and Mississippi. It is the same as sugar maple in weight, but contains more ash. It is weaker and less stiff than the other wood, and in these two properties its greatest differences from the former species are seen. In some regions it is scarce; in others it exceeds in quantity the associated species of maple. It is the only sugar maple in South Dakota. It is

[1] "Fertilizers," Edward B. Voorhees.

[2] The Indians of Dakota and of Ohio were reported as sugar makers. A place in Ohio, 20 miles from the Muskingum Ford, was known as "sugar cabins" long before white people had settled the region. See "The Journals of George Croghan," published in vol. 1 of "Early Western Travels," by Reuben C. Thwaite.

[3] "Sugar Maple and the Sugar Bush," A. J. Cook.

[4] "Transactions of the American Philosophical Society," vol. 3, p. 78.

generally used for the same purposes as sugar maple, but figures showing quantities can not be compiled, because this wood is seldom reported under its own name. Occasionally it is called black sugar maple, and more frequently hard maple.

RED MAPLE.

(*Acer rubrum.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—38.5 pounds per cubic foot (Sargent).

Specific gravity.—0.6178 (Sargent).

Ash.—0.37 per cent weight of dry wood (Sargent).

Fuel value.—83 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—11,400 pounds per square inch, or 91 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—1,297,000 pounds per square inch, or 98 per cent that of white oak (Sargent).

Heavy, hard, strong, compact, easily worked, medullary rays obscure, color brown, often tinged with red, the sapwood lighter.

Height, 75 to 100 feet; diameter, 1½ to 3 feet, occasionally larger.

SUPPLY.

Red maple grows from Canada to Florida and westward to Wisconsin, Iowa, and Texas. It reaches its best development in the lower Ohio Valley and thence southward to the valley of the Yazoo. In some portions of its range it is abundant, but in others scarce, and estimates of the commercial supply can not be made with any accuracy. Statistics of lumber cut throw little light on the subject, for the various species of maple are all grouped as one. In some instances, as in the case of broadleaf maple of the Pacific coast, the region is a guide to the species, but that does not hold for red maple, because several of the species are lumbered in the same region with it. In most instances, lumber cut from red maple passes for sugar maple. There is some difference between the woods of the two species, but not enough to be distinguished by the ordinary user. Red maple's name does not come from the color of the wood, but from the flowers, which in some situations are scarlet and in others red. The color is so striking that the trees may be identified by it almost as far as they can be seen.

MANUFACTURING.

Because the wood of this tree, when it reaches maturity, is so frequently classed as sugar maple, it is not possible to credit the red maple with all the uses which doubtless belong to it. It is known that the early makers of shoe pegs, who whittled them by hand, preferred this maple to all others. That was a very small use, however. Saddletree makers in early times found in this wood qualities which caused it to be given preference in many localities. Ox yokes de-

manded a small supply, and shovels somewhat more. Rifle stocks of red maple were common, and the claim was made—probably due to a misunderstanding—that the wood occasionally developed a wavy grain not found in any other maples.

In most furniture factories where maple is used some of it is red maple, and special mention is often made of the wood by chair factories. When woodenware was handmade, bowls and trays of red maple were preferred. The modern woodenware factory works the wood into pie and picnic plates, platters, and butter dishes. Box-makers and the manufacturers of crates and baskets for shipping berries and vegetables take the red maple on the same footing as other maples.

In North Carolina it is made into finish for passenger and electric cars. In other regions boatmakers find many places for it, and a considerable quantity goes into the manufacture of vehicles.

The bark of this maple is valued by inkmakers. It is boiled in soft water, and the tannin is combined with sulphate of iron. It is probable that the pioneers resorted to this process more frequently than present-day manufacturers. Domestic dyes also were made of it.

Chemical plants where hardwoods are converted into charcoal, acetates, and other commodities find this maple one of the best woods.

DRUMMOND MAPLE.

(*Acer rubrum drummondii.*)

The Drummond maple is a southern form of the red maple, but is lighter and lower in ash. It is not a commercially important tree, but it serves the people locally. On the lower Red River, Louisiana, a peculiarly fine class of curly and bird's-eye wood of this species has been made into gunstocks and violins. The tree's range includes parts of Tennessee, Georgia, Alabama, Florida, Louisiana, Arkansas, and Texas. Though botanists readily distinguish it from other maples, lumbermen generally do not.

SILVER MAPLE.

(*Acer saccharinum.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—32.84 pounds per cubic foot (Sargent).

Specific gravity.—0.5269 (Sargent).

Ash.—0.33 per cent weight of dry wood (Sargent).

Fuel value.—92 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—14,000 pounds per square inch, or 114 per cent that of white oak (Sargent).[1]

[1] The breaking strength and factor of stiffness were calculated from a single sample cut near Topsfield, Mass. It grew in a low meadow, and broke with long, fine splinters.

Factor of stiffness (modulus of elasticity).—1,482,000 pounds per square inch, or 112 per cent that of white oak (Sargent).

Light, hard, strong, brittle, compact, easy to work; color, light brown; medullary rays numerous, thin.

Height, 60 to 100 feet; diameter, 1½ to 3 feet; individuals occasionally much higher.

SUPPLY.

This tree is known by several names, among them swamp maple, silver maple, water maple, silver-leaved maple, river maple, white maple, and soft maple. The last name is that by which the wood is known among lumbermen, and silver maple is most frequently applied by those who plant the tree, such as nurserymen, park keepers, and the tree departments in cities. The whiteness of the leaves, particularly the under sides, suggests the name silver. It does not refer to the color of the wood, for that of other maples is as white. In fact, the wood of this maple sometimes changes color after it has been exposed to the air, and may become tinged with blue. An early reference to an American maple, believed to have been this tree, noted the blue color of the wood as its chief value in England more than a hundred years ago. "The bog maple," says Stevenson in "Trees of Commerce," "is of a beautiful pale blue color, grows in American swamps, and is sent to England in the form of veneers, and is the most handsome wood that can possibly be conceived. It is made into stationery cases and cabinet work."

The silver maple's commercial range is wide, and conforms pretty well to its botanical range, for wherever the tree grows it is used. Its importance is much below that of sugar maple, and the total quantity is certainly less, though its range is as wide. It grows in all of the States east of the Mississippi River and in several west of it. It grows rapidly, but is subject to injury and is a prey to disease. This is the maple most frequently planted in towns and cities for shade, particularly south of the northern tier of States. The commercial supply of silver maple does not come from planted trees, and probably never will, but the forest growth will be drawn upon for a long time. South of the commercial range of sugar maple, the local supply comes principally from silver maple, and the wood has a wide range of uses.

EARLY USES.

Silver maple was never thought much of as a farm timber, except that it was good fuel. Hatters preferred charcoal of this species for heating their boilers. Furniture makers cut it in strips for inlays in the manufacture of mahogany, cherry, and walnut articles. The white wood contrasted well with the darker material, but the maple did not hold its color well. Age darkened it, and the older the inlaid furniture became the less pleasing it was. Sugar makers tapped

silver maples when convenient, but the yield from them was only half that from the sugar maples. To offset this, in a measure, the sugar from the former tree was white and of milder flavor than that from the sugar maple. Large bowls for household use were occasionally made of silver maple, but it was not a choice material for that purpose and was not often taken when yellow poplar, cucumber, or basswood was available.

MANUFACTURING.

Statistical reports of manufacturers do not usually separate this wood from other maples. The industries which use the wood, however, are well known, as are the commodities into which it enters. Furniture is important, and probably makes heavier demands than any other industry. Sometimes articles are wholly of silver maple, but often it forms only a part. In veneer work it is good core material over which woods more costly or more attractive are laid. In other cases it is the frame, the drawers, or the compartments, while other woods are given the outside positions. This is true of large tables in which oak, birch, or mahogany is visible, with the interior of silver maple. Belonging in the same class are cabinets, wardrobes, large chairs, bookcases, filing cabinets, hall clocks, and bedroom suites. Silver maple is not thus employed because it is better than other available woods, but because it will answer and is convenient and cheap. It is much lighter and weaker than sugar maple. Some prefer it because it is light. When it is made into kitchen cabinets, refrigerators, ice boxes, and pantry shelves and tables it is the outside wood. Its light color and clean appearance are considered in selecting it for this use. Kitchen and camp chairs are occasionally made of it, and it is found in the frames of cots and couches, where its moderate weight is appreciated. The long, pliant branches, an inch or less in diameter, bend easily and are much employed in making rustic porch seats and other outdoor furniture. The manufacturers of lawn swings list the wood among their supplies.

Silver maple is quite satisfactory for interior finish for houses and electric cars. Office and store fixtures, such as counters, shelving, partitions, show cases, and cabinets, are often made wholly or in part of silver maple; and in quality it is only a little below sugar maple for flooring, and is sometimes seen in parquetry, but its tendency to change color with age must be considered when it is combined with other wood to form contrasts. Doors and door frames and stair work draw supplies from it, and it makes excellent molding. In Louisiana the wood is liked for boat floors and in Michigan for boat trim and stairways. It is a substantial wood and in general use in the manufacture of agricultural implements. It does not seem to be selected for this purpose because of special fit-

ness, but because it is convenient and unobjectionable. It is manufactured into tool boxes on mowing machines, reapers, and seed sowers, parts of corn planters, garden cultivators, fanning mills, grass seeders, potato planters, and root cutters. It is most frequently used for hoppers. The largest demand for silver maple in implement work appears to come from Illinois, and the supply is derived from the South rather than from the North. Silver maple reaches its best development and largest size in the lower Ohio Valley.

It is not largely employed for vehicles, but is preferred to many other woods for the handles of baby carriages and gocarts to be finished in white enamel. Children's cribs, for the same reason, are made of the wood. Hand sleds and parts of automobile frames take some of it, and it is used by makers of railroad velocipedes.

Many articles belonging to woodenware show the use of silver maple—veneer plates, butter bowls, bread boards, ironing boards, clothes dryers, mangles, sleeve boards, broom handles, carpet sweepers, and coat hangers. Boxmakers in nearly all parts of eastern United States use silver maple, and often in large quantities. Perhaps more is made into crates than boxes. Egg cases are specially mentioned, and near akin to them brooders and incubators. Signboards, reels on which to wind barbed wire, umbrella racks, picture frames, hay racks, and ballot boxes are in the miscellaneous list of articles in the manufacture of which silver maple finds a place. It is a rather important material in manual-training supplies, school apparatus, tool handles, and professional and scientific instruments.

BROADLEAF MAPLE.

(*Acer macrophyllum.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—30.59 pounds per cubic foot (Sargent).

Specific gravity.—0.49 (Sargent).

Ash.—0.54 per cent of weight of dry wood (Sargent).

Fuel value.—66 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—9,590 pounds per square inch, or 77 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—1,065,000 pounds per square inch, or 81 per cent that of white oak (Sargent).

Light, soft, not strong, compact, easily worked, susceptible of a good polish, medullary rays numerous, thin, color light brown, tinged with red, sapwood often nearly white.

Height, 75 to 100 feet; diameter, 2 to 4 feet.

SUPPLY.

This western tree is known by several other names besides broadleaf maple. It is frequently called Oregon maple, because it reaches

its best development in the southwestern part of that State. Other names for it are white maple and bigleaf maple. Its leaves are sometimes a foot wide, though usually not that large. Its range extends from latitude 55° on the coast of Alaska south to San Diego County, Cal., a distance of nearly 2,000 miles, but east and west it occupies a comparatively narrow strip. In the north it seldom extends more than 2,000 feet above sea level, but in southern California it is found at an altitude of 6,000 feet. In many parts of its range the tree is not of size and shape fit for lumber, but in Oregon a considerable quantity is cut and 2,500,000 feet are manufactured annually into finished products. The shape of the tree is not ideal from the lumberman's viewpoint, the trunk being short. It does not often grow in pure stands, but the trees are dispersed along the banks of streams and on fertile bottom lands. No estimate of the total stand of the species can be made from available data. In 1909 only 12 sawmills in Oregon and 9 in Washington reported this wood in their output, though doubtless many others produced small quantities of the lumber, but did not consider it necessary to include it in their reports. It is not mentioned in statistics of California sawmill output, though it grows in both the Sierra Nevada and Coast Range Mountains over a distance of 600 or more miles.

EARLY USES.

It has been claimed that the broadleaf maple is the most valuable hardwood of the Pacific coast. Some even give it qualities equal to sugar maple of the East. This is claiming more than is shown by a comparison of its physical properties with those of the eastern species, to which it is inferior.

The broadleaf maple was made into gunstocks more than 60 years ago by settlers in what is now Oregon. It produces curly and bird's-eye wood, as do the eastern maples, and that led to a number of uses, though for a long time the total demand was small. The Indians were making bowls of it when the white emigrants reached the northwestern coast. Sugar was made from the sap and supplied the settlers in the new country at a time when other sugar was hard to get. Some of this maple was cut for fuel, but it is rather low grade and so much inferior to some of the oaks associated with it that woodcutters usually passed it by. It served for fences when farms were cleared, but it was no better than several other species which were more plentiful, and, of course, was not hauled far. In a few instances the pioneer water mills in Oregon made broad planks of it, and the settlers floored their houses with maple. Some of the finest stands of broadleaf maple were sacrified when the pioneers cleared their farms, for it grew on the best bottom lands. A very small quantity was made into farm implements, each farmer usually cutting to meet his own needs and working up the wood in his spare hours.

MANUFACTURING.

With the settlement of the country and the multiplication of industries, the native maple was more appreciated. At the present time the largest demand for the wood comes from furniture factories and planing mills which make flooring. Veneer cutters manufacture a panel, glued together three or five ply, which is employed by furniture makers or for the interior finish of houses, offices, stores, and halls. Veneers of cheaper kinds are worked into fruit and vegetable baskets, boxes, and crates. The abundance and cheapness of softwoods prevent much use of maple for merchandise shipping boxes, yet there is some demand, particularly for crating machinery and vehicles. Boat builders on the Pacific coast make finish of the native maple for cabins, railing, frames, doors, and stairways. It serves as counter tops, table tops in butcher shops, show cases in dry-goods stores, and desks in bank and office buildings.

It is a favorite wood for school desks and other furniture, apparatus, and appliances of the schoolroom. Rollers for sawmills, particularly for offbearing lumber, are often of this wood; also large rollers employed in moving houses.

It is selected for molding, particularly the kind used in making picture and mirror frames, carved work, such as pedestals and capitals, newel posts, and various ornaments, grills, spindles, and dowels.

It is considered one of the best handle woods of the Pacific coast, and ax handles are among its uses of that kind, though inferior to hickory and several other eastern woods. Trunk makers use maple slats to reenforce their products, and the wood is good pulley material in machine shops. The pulley maker procures some of his material from the left-overs of furniture factories.

On the Pacific coast maple is considered, next to alder, the best material for broom handles, but it does not appear that the total amount demanded by that industry is large. Its chief commendation is its light color and the good polish it takes, though its comparatively light weight is also in its favor. It is serviceable for pack saddles and tent toggles, and in the mountain regions for snowshoe frames, but the total requirement is small. The western maple is sometimes stained in imitation of white oak and mahogany.

It is not likely that the available supply of broadleaf maple wood will increase, since the natural growth is disappearing, and planting is seldom undertaken.

BOX ELDER.

(*Acer negundo.*)

PHYSICAL PROPERTIES.

Weight of dry wood.—26.97 pounds per cubic foot (Sargent).
Specific gravity.—0.4328 (Sargent).
Ash.—1.07 per cent weight of dry wood (Sargent).

Fuel value.—58 per cent that of white oak (Sargent).

Breaking strength (modulus of rupture).—7,400 pounds per cubic foot, or 60 per cent that of white oak (Sargent).

Factor of stiffness (modulus of elasticity).—805,000 pounds per cubic foot, or 61 per cent that of white oak (Sargent).

Wood light, soft, weak, compact, medullary rays numerous, thin, color creamy white, the thin sapwood hardly distinguishable.

Height, 45 to 75 feet; diameter, 18 to 36 inches, occasionally larger, but in some regions much smaller.

SUPPLY.

Box elder, including its California variety, has a range of nearly 4,000,000 square miles, which is exceeded by few American trees. In many portions of its extended range, however, the tree is very scarce, and in other regions the growth is too small to be of importance. Here and there box elder timber is put to use, but the total quantity used is very small for a range so large. The species reaches its best development in the valleys of the Wabash and Cumberland Rivers. From Vermont it ranges to Florida, though it is rather rare east of the Allegheny Mountains. It extends west from New England through Canada to the base of the Rocky Mountains on the Saskatchewan River, thence southward along the eastern base of the Rocky Mountains into Mexico. A variety crosses the mountain into Arizona and covers the southern half of California. The tree resembles both ash and maple, and is called ash-leaved maple, cut-leaved maple, negundo maple, black ash, stinking ash, sugar ash, and water ash.

EARLY USES.

It appears that the wood's white creamy color led to its first use for manufacturing purposes. Early in the nineteenth century the makers of mahogany, cherry, and black walnut furniture in the Eastern States employed it for inlay and other ornamentation. The contrast between the white wood of this tree and the dark cabinet woods with which it was associated was all that could be desired. Its color also gave it a place in the early manufacture of dishes and other woodenware. Its habit of growing on fertile land made it the enemy of the first settlers who cleared those lands for farms, and it was cut in comparatively large quantities without being put to any use, except occasionally in the construction of fences or for fuel. It was rather poor material for both.

MANUFACTURING.

With so wide a range box elder is of necessity put to many uses. Anything approaching a complete list of these is hard to procure, for the wood, like many other minor species, loses its name and identity as soon as it reaches the sawmill, and often before the saw log gets out of the woods. It is ash or maple when the furniture factory or the planing mill receives it. If it is considered a maple it is the weakest and least elastic of them all; if it is an ash it does

not compare favorably with other ashes. At the best, it is a rather poor material for manufacturing purposes where strength and stiffness are demanded, but in color it is superior to most of the common white woods.

It is made into interior finish in Michigan, North Carolina, and California. The particular uses for it are as newel posts, stair rails, spindles, capitals, chair boards, and baseboards, occasionally doors and frames, and more frequently flooring.

It is turned to account as handle material, but not where strength and stiffness are essential. Broom handles of this wood present a handsome appearance, and doubtless many thousands listed as maple in the markets are box elder. Woodenware makers draw supplies from this source, and the wood's clear color is its principal recommendation. Ironing boards, sleeve boards, washboards, bread and meat boards, chopping blocks, and the tops of kitchen tables, and shelves for pantries are among the commodities in which box elder gives its best service. Some of it is cut for pulp, but it is not separately listed. It appears in the same way in slack cooperage. It is not believed that the quantity so used is very large compared with some other species, but coopers employ it for numerous wares and in many parts of the country.

The California variety, *Acer negundo californicum*, is generally smaller than the eastern form, and does not serve in as many places because industries are not as varied on the Pacific coast as in the East. The western form differs from the eastern in having wood somewhat heavier, but only half as much ash when burned. It is 50 per cent stronger and 70 per cent stiffer, and is therefore a better wood for vehicles, handles, and for the manufacture of agricultural implements.

VINE MAPLE.

(*Acer circinatum.*)

Vine maple is a western species with a range more restricted than that of the broadleaf or Oregon maple. It is found from the coast region of British Columbia south through Washington and Oregon to northern California. The tree is not of much commercial importance because it is small and rather scarce, but it is put to several uses in parts of its range. Lumbermen make ax handles of it in Oregon, and it gives good service in shovel and small-tool handles. Indians prefer it for fishing net bows. It is not half as stiff as sugar maple. The name vine maple is given this species because of the trunk's habit of lying on the ground. There is small probability that its importance will increase in the future.

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